Twentieth ANNUAL METAL CONGRESS Issue

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THE IRON AGE

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RYERSON STEEL-SERVICE

All Aboard FOR DETROIT

OCTOBER 17 ★ 21

Reservations are pouring in. Metal men are coming by train . . . by automobile . . . by bus . . . by plane . . . and by ocean liner . . . the progressive far-sighted men of metal of this and other nations, men who realize that, under today's conditions and in the face of today's competition, no one can know too much about his job and his specialty.

Four great technical societies are co-operating to assure you five days filled to the brim with inspiration, education and stimulating contacts—five days that will re-charge your brain-cells and send you home better equipped to face the problems of the months ahead.

The question isn't—"Can you afford to come" . . . the true question is—"Can you afford not to come" . . . can you risk letting others monopolize the benefits of attendance at the world's greatest annual event in the Metal Industries?

Co-operating societies—
American Society for Metals; Wire Association; Institute of Metals Division and Iron and Steel Division of A.I.M.E.; American Welding Society.

•

More than 52 technical sessions with prepared papers and talks by the nation's recognized authorities on the metallurgy, fabrication, treatment, inspection and testing of ferrous and non-ferrous metals.

•

More than 200 carefully developed exhibits by leading manufacturers serving the Metal Industries.

Under the auspices of American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio

NATIONAL METAL EXPOSITION

METAL MEN PREPARE

IT'S bitterly true that comparatively little steel has passed under the nation's rolling mill pulpits since the leaders in metal production, metal fabrication and metal treatment adjourned their Atlantic City meeting last October. But depressive as red ink on ledgers is, research has spurted rather than faltered, and the past twelve months has witnessed more than its share of machines come off the designing boards, alloys emerge from the laboratories and operating techniques pass from the costly and experimental to the dependable and profitable stage.

So again the metal men have an elaborate and instructive story to tell each other and an international audience of a probable 20,000, and again they all will meet, this time for the twentieth time in America's fourth largest metropolis, Detroit, a city which is itself symbolic of American ingenuity, industrial enterprise and mass production. Two great societies again join with the A.S.M. to present technical programs running the gamut of engineering subjects—the American Society for Metals for the most part featuring ferrous metallurgy; the American Society of Mining and Metallurgical Engineers dividing its attention between ferrous and nonferrous metallurgy, mostly of a theoretical nature; and the American Welding Society as usual sketching out the most recent advances in fundamental metallurgy backed up with a myriad of new wrinkles in the cutting and joining of metals.

This year the congress was to have enjoyed the added fillip of a visit of several hundred members of the British Iron and Steel Institute and the British Institute of Metals, who were thus to have completed their three-weeks tour of the industrial and research establishments of this country. Unfortunately, however, this entire visit was cancelled late in September.

Detroit affords the congress particular advantages by being not only the world center of the automobile industry, but by having nearby several very large steel mills and copper and brass rolling mills, the leading stove manufacturing plant in the world, and leading adding machine, pharmaceutical and electrical refrigeration plants. Inspection trips to many of these important plants are naturally major features of the congress.

With all of the 90,000 sq. ft. of exhibition space accounted for several months ago, the exposition of metals, equipment and processes without doubt should be the most elaborate, informative and costly of any such un-

Million Dollar Exposition...

Twentieth National Metal Congress and Exposition, Detroit, Oct. 17-21

dertaking in this country. Over 230 leading companies have taken space in Convention Hall, over $100,000 has been paid for the space, and just about $1,000,000 worth of exhibitions is now being poured into the space to afford visitors a full range of working models of metallurgical operations.

displays of new products, and demonstrations of new methods and processes.

THE A.S.M. program gets off to a fast start on Monday, Oct. 17, with two simultaneous morning sessions, and before the week is ended 49 lectures by some 76 authors will have been presented. One high point of the program is a two-day symposium, Thursday and Friday, the subject being "Effects of Alloying Elements on the Hardenability of Medium and Low Alloy Steels." The list of participants features such illustrious names as R. F. Mehl of the Carnegie Institute of Technology, Dr. Davenport of the U. S. Steel research laboratories, Carnegie-Illinois's M. A. Grossman, H. W. McQuaid of Republic, W. E. Jominy, G. C. Riegel, G. V. Luerssen, and many others.

One educational course, on machineability will consist of five lectures presented daily in the late afternoon by five different experts on various aspects of the subject.

The first lecture on "Physics of Cutting" will be given by Hans Ernst, research director, Cincinnati Milling Machine & Cincinnati Grinders, Inc. Australian born and educated, Mr. Ernst spent eight years with Western Cartridge Co. in research and machine development work, and has been in Cincinnati for the past 12 years.

H. B. Knowlton, who is to give the second lecture, "Machining Wrought

PHILIP GEORGE LANG, Jr.

JAMES T. MacKENZIE

G. B. WATERHOUSE

S.A.E. Steels, Ingot Iron, Wrought Iron and Stainless Steel," is the author of a book on "Heat Treatment, Properties and Uses of Steel," published some years ago by the A.S.M. He is a metallurgist for International Harvester Co. in Chicago.

The third lecture will deal with machining cast steel, cast iron and wrought iron. The author, John Ward Bolton, is chief chemist and metallurgist of Lunkenheimer Co., Cincinnati, and is also the author of a recent book on "Gray Cast Iron" as well as a multitude of technical papers on cast iron.

Past A.S.M. President A. H. d'Arcambal will discuss the machining of tool steels. He has been intimately connected with the tool steel and small tool industry for many years, having been with Pratt & Whitney Co. since 1919, and now is the consulting metallurgist and sales engineer of the small tool division. He will be assisted by W. E. Bancroft, chief metallurgist for the Pratt & Whitney Company.

The machining of non-ferrous metals, cast and wrought, will be covered in the final lecture by H. P. Croft, metallurgist for Chase Brass & Copper Co., Cleveland.

A shorter lecture course on the subject of "Pyrometry" will be conducted on three successive evenings during the congress by Robert B. Sosman, physical chemist, U. S. Steel Corp. Research Laboratories, Kearny, N. J. Dr. Sosman was a physicist in the geophysical laboratory of the Carnegie Institute, Washington, for 20 years before joining U. S. Steel in 1938.

A. L. Boegehold, chief metallurgist, General Motors Research Laboratories, Detroit, has been selected to deliver the Campbell Memorial Lecture. This paper will undoubtedly draw a very large attendance.

The annual banquet of the American Society for Metals is scheduled for Thursday, Oct. 20, and various special luncheon meetings will include the Canadian luncheon of the Montreal and Ontario chapters on Tuesday, and a group of alumni luncheons on Wednesday following the Campbell Memorial Lecture.

THE rapidly growing welding society has arranged for 48 technical papers, the number and quality of which are probably without precedent. Practically every welding authority is scheduled to talk at least once, and the subjects covered range through all-important fundamental research and into all major practical applications of the varied welding processes of the present day.

Headquarters for the welders will be at the Book-Cadillac Hotel. The convention will open with the president's reception during the late afternoon of Sunday, Oct. 16. The first technical session, the next morning, will be devoted to welding in construction work, and will be followed

American Society for Metals

HANS ERNST

R. B. SOSMAN

A. H. d'ARCAMBAL

ROBERT F. MEHL

A. L. BOEGEHOLD

o o o

Metal Congress-Men

P. G. LANG, Jr., is president of the American Welding Society; J.T. MacKenzie is chairman of the Iron and Steel Division, and R. F. Mehl is chairman of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers; G. B. Waterhouse heads the American Society for Metals, and A. L. Boegehold will feature the technical program with his Campbell Memorial Lecture.

o o o

in the afternoon by simultaneous sessions on the production welding of small machine parts and industrial research, respectively. Welding and cutting processes and fundamental research are the general topics of simultaneous sessions planned for the morning of Oct. 18. These will be followed by a joint session with the American Society of Mechanical Engineers and a second session devoted to reports on fundamental research. In addition, another conference on fundamental research is planned for the evening of Oct. 18.

Welding in machine design, and industrial research—the latter featuring a symposium on copper alloy welding—are topics of simultaneous sessions to be held on the morning of Oct. 19. The following day, both morning and afternoon will be entirely devoted to discussions of various applications of welding in the automotive industry. Papers covering ship and boat welding and railroad welding will feature the closing technical sessions, to be held simultaneously on the morning of Oct. 21.

The concluding event of the convention will be the annual business meeting and election of officers, and presentation of the Samuel Wylie Miller Memorial Medal and the Lincoln Gold Medal, the recipients of which will not be announced until sometime during the meeting. At the society's annual dinner, Oct. 20, W. J. Cameron, Ford Motor Co., will be the principal speaker. Arrangements have been made for a number of plants in the Detroit area to be open for inspection.

Educational Lecturers

W. P. CROFT

J . W. BOLTON

H. B. KNOWLTON

Non-Ferrous Metallurgy Stressed

THE Iron and Steel and the Institute of Metals divisions of the A.I.M.E. have joined for simultaneous sessions from Monday through Thursday. On Monday and Tuesday the metals division is concerned primarily with theoretical aspects of copper alloys and bearing metals, and at the same time the steel division will deal with ferrous metallurgy, with many timely papers scheduled, as for instance, "Solidification of Rimming Steel Ingots," by A. Hultgren and G. Phragmen, of the Metallografiska Institute, Sweden; "The Structure of Iron After Compression," by C. S. Barrett, Carnegie Institute of Technology; "Reduction of Iron Ores Under Pressure," by Michael Tenenbaum and C. L. Joseph, University of Minnesota, and numerous others.

There will be no technical sessions of the A.I.M.E. Divisions on Wednesday morning, in order to leave members free to attend the annual Campbell Memorial Lecture of the American Society for Metals.

Wednesday evening will be devoted to a continuation of past round table discussions on the physics of metals, in this instance the subject under particular examination being, "The Nature of Hardness."

Correlated Technical Program

MONDAY, OCT. 17

9:30 A.M. ←

Presentation of A.W.S. medals; address of welcome by R. W. Reading, Mayor of Detroit.

Oxy-Acetylene Welding of Carbon-Molybdenum Steel Pipe, A. N. Kugler, Air Reduction Sales Co.; *Single Pass Electric Welding of Unfired Pressure Vessels*, R. M. Wallace, the Griscom Russell Co.; *Welding Structures*, Albert S. Low, the Austin Co., A.W.S., Italian Garden, Book-Cadillac.

10:00 A.M.

Softening Rate of a Steel When Tempered from Different Initial Structures, E. H. Engel, Carnegie-Illinois Steel Corp., A.S.M., Hotel Statler Ball Room.

Relation Between the Rockwell C and Diamond Pyramid Hardness Scales, H. Scott and T. H. Gray, Westinghouse Electric & Mfg. Co., A.S.M., Hotel Statler Michigan Room.

Absolute Hardness, E. G. Mahin and G. J. Foss, Jr., University of Notre Dame, A.S.M.

Rates of Diffusion of Copper and Zinc in Alpha Brass, E. O. Kirkendall, Wayne University, L. Thomassen and C. Upthegrove, University of Michigan, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Reduction of Iron Ores Under Pressure, M. Tenenbaum and C. L. Joseph, University of Minnesota, A.I.M.E., Washington Room, Book-Cadillac.

10:40 A.M.

Selective Hardening with the Oxy-Acetylene Flame, R. L. Rolf, Lakeside Steel Improvement Co., A.S.M., Hotel Statler Ball Room.

Effects of Fibre on the Notch Toughness of Mild Steel as Influenced by Cooling Rate, O. W. Ellis, Ontario Research Foundation and J. E. McDonell, Queen's University, A.S.M., Hotel Statler Michigan Room.

Plastic Deformation and Subsequent Recrystallization of Single Crystals of Alpha Brass, M. R. Pickus and C. H. Mathewson, Yale University, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Induction Furnaces for Rotating Liquid Crucibles, E. P. Barrett, W. F. Holbrook and C. E. Wood, U. S. Bureau of Mines, A.I.M.E., Washington Room, Book-Cadillac.

11:20 A.M.

Reaction to Annealing above the Eutectoid Temperature of Quenched Hypereutectoid Steels, C. R. Austin and M. C. Fetzer, Pennsylvania State College, A.S.M., Hotel Statler Ball Room.

New Method for the Rapid Determination of Carbon in Samples of Plain Carbon Open Hearth Steel, B. A. Rogers, Karl Wentzel and J. P. Riott, Bureau of Mines, A.S.M., Hotel Statler Michigan Room.

Development of Abnormally Large Grain Sizes in Rolled and Annealed Copper Sheet, Maurice Cook and C. Macquarie, I.C.I. Metals, Ltd., A.I.M.E., Crystal Ball Room, Book-Cadillac.

Solubility and Diffusion of Oxygen in Solid Iron, A. B. Wilder, University of Illinois, A.I.M.E., Washington Room, Book-Cadillac.

2:00 P.M.

Effects of Special Alloy Additions to Stainless Steels, R. Franks, Union Carbide & Carbon Research Laboratories, Inc.; *Stress-Corrosion Cracking in Austenitic Stainless Steels*, S. L. Hoyt and M. A. Scheil Co., A. O. Smith Corp., A.S.M., Convention Hall.

Superlattices; The Effect of Silver on the Gold-Copper Superlattice, R. Hultgren, Harvard University, and L. Tarnopol, University of Kentucky, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Effect of Hot Metal Analysis and Casting Temperature on the Quality of Open Hearth Steel, L. H. Nelson, Republic Steel Corp., A.I.M.E., Washington Room, Book-Cadillac.

Welding, Cutting and Machine Design of Small Sub-Assemblies, Edward J. DeWitt, Wallace Supplies Mfg. Co.; *Welding as Applied to Fabrication of Industrial Stokers*, F. R. Mason, Riley Stoker Corp., A.W.S., Italian Garden, Book-Cadillac.

Physical and Chemical Properties of the Nickel-Iron Alloys Formed in the Welding of Nickel Clad Steel, W. G. Theisinger, Lukens Steel Co., J. H. Deppeler, Metal & Thermit Corp., and F. G. Flocke, International Nickel; *Weldability of Medium Carbon Steel*, R. W. Emerson, Westinghouse Electric & Mfg. Co., A.W.S., Grand Ball Room, Book-Cadillac.

2:40 P.M.

Some Observations on the Passivity of Stainless Steels, J. N. Ostrofsky, Rustless Iron & Steel Corp., A.S.M., Convention Hall.

Plastic Flow of Metals, C. W. MacGregor, Massachusetts Institute of Technology, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Solidification of Rimming Steel Ingots, A. Hultgren and G. Phragmen, Metallografiska Institutet, Sweden, A.I.M.E., Washington Room, Book-Cadillac.

Methods for the Manufacture of Precision Assemblies by Resistance Welding, F. D. Rogers, International Business Machines Corp.; *Arc Welding as Influenced by Shop Preparation, Tools, Jigs and Fixtures*, M. S. Evans, American Car & Foundry Co., A.W.S., Italian Garden, Book-Cadillac.

Effect of Current, Pressure and Time on the Shear Strength and Structure of Spot Welds in the Aluminum Alloys, G. O. Hoglund and G. S. Bernard, Jr., Aluminum Co. of America; *Investigation of Arc and Gas Welding Joints in Aluminum and Aluminum Alloys*, R. K. Wells and A. G. Bissell, Navy Department, A.W.S., Grand Ball Room, Book-Cadillac.

3:20 P.M.

Electron Diffraction Effects from Polished Zinc Surfaces, M. L. Fuller, New Jersey Zinc Co., A.I.M.E., Crystal Ball Room, Book-Cadillac.

Mechanism of Solidification and Segregation in a Low Carbon Rimming Steel Ingot, A. Hayes, American Rolling Mill Co., and J. Chipman, Massachusetts Institute of Technology, A.I.M.E., Washington Room, Book-Cadillac.

4:30 P.M.

Physics of Cutting, educational lecture, Hans Ernst, Cincinnati Milling Machine Co., A.S.M., Convention Hall.

8:00 P.M.

Pyrometry, educational lecture, R. B. Sosman, U. S. Steel Corp., A.S.M. Convention Hall.

TUESDAY, OCT. 18

9:30 A.M.

Influence of Chromium, Silicon and Aluminum on the Oxidation Resistance of Intermediate Alloy Steels, A. E. White, C. L. Clark, University of Michigan, and C. H. McCollam, Timken Roller Bearing Co., A.S.M., Hotel Statler Ball Room.

Some Properties of Oxygen-Free High Conductivity Copper, C. G. Goetzel, Hardy Metallurgical Co., A.S.M., Hotel Statler Michigan Room.

Welding of Ammonia Containers, E. H. Behling, Vilter Mfg. Co., A.W.S., Italian Garden, Book-Cadillac.

Quick Shop Test for Quality of Weld and Its Correlation with the Standard Tests, W. J. Conley, University of Rochester; *Effect of Rigid Beam-Column Connections on Column Stresses*, Ingle Lyse and E. H. Mount, Lehigh University, A.W.S., Grand Ball Room, Book-Cadillac.

10:00 A.M.

Influence of Aluminum on Cast Corrosion Resisting Steel, J. A. Duma, Norfolk Navy Yard, A.S.M., Hotel Statler Ball Room.

New 70/30 Nickel-Copper Alloy Subject to Precipitation Hardening, Erich Fetz, Wilbur B. Driver Co., A.S.M., Hotel Statler Michigan Room.

Micro-Hardness of Bearing Alloys, L. L. Swift, Cleveland Graphite Bronze Co.; *Effect of Silver Additions to Tin Bronze*, A. J. Dornblatt and A. M. Setapen, National Bureau of Standards, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Fracture of Steels at Elevated Temperatures, R. H. Thielemann and E. R. Parker, General Electric Co.; *Effect of Phosphorus on the Properties of Iron*, Heihachi Kamura, Meji College of Technology, Japan, A.I.M.E., English Room, Book-Cadillac.

Brazing Tubes in High Pressure Boilers with Silver Alloys, A. W. Weir, New York Central Railroad, and H. M. Webber, General Electric Co., A.W.S., Italian Garden, Book-Cadillac.

Residual Stresses Due to Circumferential Welds in Pipes, E. L. Eriksen, University of Michigan; *Welding Arcs from the Standpoint of Recent Investigations*, C. G. Suits, General Electric Co., A.W.S., Grand Ball Room, Book-Cadillac.

10:40 A.M.

Development in Molybdenum High Speed Cutting Steels, W. R. Breeler, Ludlum Steel Co., A.S.M., Hotel Statler Ball Room.

Effects of Substantial Additions of Aluminum, Cobalt, Titanium and Columbium on the Properties of 80 Ni-20 Cr Alloys, A. L. Sanford and O. E. Harder, Battelle Memorial Institute, A.S.M., Hotel Statler Michigan Room.

Possibilities of Silver-Rich Alloys as Bearing Materials, R. W. Dayton, Battelle Memorial Institute, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Structure of Iron after Compression, C. S. Barrett, Carnegie Institute of Technology, A.I.M.E., English Room, Book-Cadillac.

2:00 P.M.

Production of Flakes by Treating Molten Steel with Hydrogen and the Time of Cooling Necessary to Prevent Their Formation, R. E. Cramer and E. C. Bast, University of Illinois, A.S.M., Convention Hall.

Age Hardening of Duralumin, M. Cohen, Massachusetts Institute of Technology; *Effect of Plastic Deformation on the Age Hardening of Duralumin*, R. W. Lindsay and J. T. Norton, Massachusetts Institute of Technology, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Kinetics of the Decomposition of Austenite at Constant Temperature, J. B. Austin and R. L. Rickett, U. S. Steel Corp., A.I.M.E., English Room, Book-Cadillac.

Quality and Efficiency in Oxygen Cutting, G. M. Deming, Air Reduction Sales Co.; *Bi-Metal Construction of High Temperature Steel Valves*, E. R. Seabloom, Crane Co., A.W.S., Italian Garden, Book-Cadillac.

Photo-Elastic Analysis of Stresses in the Lap Plates of Welded Joints, A. G. Solakian, Polarized Light Co.; *Metallurgical Aspects of Resistance Welding Electrodes*, R. H. Harrington, General Electric Co., A.W.S., Grand Ball Room, Book-Cadillac.

A.S.M., A.W.S., A.I.M.E.

2:40 P.M.

Effect of Carbon Content on the Oxidation of Steel, C. A. Siebert, University of Michigan, A.S.M., Convention Hall.

Weld Penetration, John Hruska, Electro-Motive Corp.; *Bronze-Welding,* W. S. Walker, Linde Air Products Co., A.W.S., Italian Garden, Book-Cadillac.

3:20 P.M.

Some Effects of Deoxidizers in Low Carbon—1.5 Per Cent Chromium Steel, W. Crafts and J. L. Lamont, Union Carbide & Carbon Research Laboratories, Inc., A.S.M.

Low Temperature Transformation in Fe-Ni-Co Alloys, L. L. Wyman, General Electric Co.; *Thermal Expansion of Nickel-Iron Alloys (Nickel 30-70 Per Cent),* J. M. Lohr and C. H. Hopkins, Driver-Harris Co., A.I.M.E., English Room, Book-Cadillac.

Crater Formation in Arc Welding, G. E. Doan, Lehigh University; *Creep Test of Arc-Welded Low Carbon Steel,* N. F. Ward, University of California; *Stress Distribution in Welds Subjected to Bending,* C. D. Jensen and R. E. Crispen, Lehigh University, A.W.S., Grand Ballroom, Book-Cadillac.

4:30 P.M.

Machineability of Ingot Iron, Wrought Iron, S.A.E. Steels and Stainless Steels, educational lecture, H. B. Knowlton, International Harvester Co., A.S.M., Convention Hall.

Solubility of Pb and Bi in Liquid Al and Al-Cu Alloys, L. W. Kemf and Kent R. Van Horn, Aluminum Co. of America, A.I.M.E., Crystal Ballroom, Book-Cadillac.

7:30 P.M. ←

Banquet, A.I.M.E. Divisions, Crystal Ballroom, Book-Cadillac.

8:00 P.M.

Pyrometry, educational lecture, R. B. Sosman, U. S. Steel Corp., A.S.M., Convention Hall.

WEDNESDAY, OCT. 19

9:30 A.M.

Recent Developments in Welding of Machine Tool Structures, L. F. Nenninger and W. A. Maddox, Cincinnati Milling Machine Co., A.W.S., Italian Garden, Book-Cadillac.

Progress in Copper Welding, Ira T. Hook and Clinton E. Swift, American Brass Co.; *Carbon Arc Welding of Silicon Bronze,* E. S. Bunn, J. R. Hunter, and W. G. Seidlitz, Revere Copper & Brass, Inc., A.W.S., Grand Ball Room, Book-Cadillac.

10:00 A.M. ←

Annual Meeting of the American Society for Metals and presentation of 1938 Edward De Mille Campbell Memorial Lecture by A. L. Boegehold, head of metallurgical department of General Motors Corp.; Hotel Statler.

Machine Flame Cutting with Small Machines, Otto C. Voss, Allis-Chalmers Mfg. Co.; *Welding and Cutting in Machinery Construction,* J. Gordon, Taylor Winfield Corp., A.W.S., Italian Garden, Book-Cadillac.

Studies of the Spot Welding of Low Carbon and Stainless Steel, W. F. Hess and R. L. Ringer, Rensselaer Polytechnic Institute; *Stresses in Welds,* M. F. Sayre and E. A. Winzenburger, Union College, A.W.S., Grand Ball Room, Book-Cadillac.

2:00 P.M.

Graphitizing Rate and Nodule Number, H. A. Schwartz and M. K. Barnett, National Malleable & Steel Castings Co., A.S.M., Convention Hall.

Tarnish Films on Copper, J. B. Dyess and Henry A. Wiley, Oklahoma Agricultural and Mechanical College, A.I.M.E., Crystal Ball Room, Book-Cadillac.

2:40 P.M.

Effect of Type of Cold-Deformation on the Recrystallization Properties of Armco Iron, H. F. Kaiser and H. F. Taylor, Naval Research Laboratory, A.S.M., Convention Hall.

Special Methods for Polishing Steel Metal Specimens for Metallographic Examination, D. Bergekoff and W. D. Forgeng, Union Carbide & Carbon Research Laboratories, Inc.; *Studies Upon the Corrosion of Tin, II—The Effects of Other Anions in Carbonate Solutions,* G. Derge and H. Markus, Carnegie Institute of Technology, A.I.M.E., Crystal Ball Room, Book-Cadillac.

4:30 P.M.

Some Factors Affecting the Machineability of Cast Steel, Cast Iron and Malleable Iron, educational lecture, J. W. Bolton, Lunkenheimer Co., A.S.M., Convention Hall.

8:00 P.M.

Pyrometry, educational lecture, R. B. Sosman, U. S. Steel Corp., A.S.M., Convention Hall.

THURSDAY, OCT. 20

9:30 A.M.

White Layer Structure in the Erosion of Machine Gun Barrels, W. H. Snair, American Can Co., and W. P. Wood, University of Michigan, A.S.M., Hotel Statler Ball Room.

Possible Uses of Radioactive Substances in the Testing of Metals, H. F. Kaiser, Naval Research Laboratories, A.S.M., Hotel Statler Michigan Room.

Flame Hardening with the Oxy-Acetylene Flame, H. J. Shepperd, Kelsey Hayes Wheel Co., A.W.S., Italian Garden, Book-Cadillac.

10:00 A.M.

Influence of Microstructure upon the Process of Diffusion in Solid Metals, F. N. Rhines and C. Wells, Carnegie Institute of Technology, A.S.M., Hotel Statler Ball Room.

Color Carbon and Aging, C. L. Shapiro, Consulting Engineer, A.S.M., Hotel Statler Michigan Room.

Equilibrium Relations in Aluminum-Zirconium Alloys of High Purity, W. L. Fink and L. A. Willey, Aluminum Co. of America, A.I.M.E.; *Solubility of Lead and Bismuth in Liquid Aluminum and Aluminum Alloys,* L. W. Kempf and K. R. Van Horn, Aluminum Co. of America, A.I.M.E., Crystal Ball Room, Book-Cadillac.

Automobile Body Welding, E. H. Foss, Murray Corp. of America; *Welding of Rear Axle Housings,* E. L. Bailey and V. Knecht, Chrysler Corp., A.W.S., Italian Garden, Book-Cadillac.

10:40 A.M.

Study of Carbide Solution in Hypoeutectoid Plain Carbon and Low Alloy Commercial Steels, R. H. Lauderdale and O. E. Harder, Battelle Memorial Institute, A.S.M., Hotel Statler Ball Room.

Hardness Gradients in Tempered Steel Cylinders, C. A. Rowe and R. A. Ragatz, University of Wisconsin, A.S.M., Hotel Statler Michigan Room.

2:00 P.M.

Physics of Hardenability—Mechanism and the Rate of the Decomposition of Austenite, R. F. Mehl, Carnegie Institute of Technology, A.S.M., Convention Hall.

Resistance Welding in the Automotive Industry, A. DiGiulio, Ford Motor Co., A.W.S., Italian Garden, Book-Cadillac.

2:40 P.M.

Hardenability, Its Relation to Quenching and Some Quantitative Data, M. A. Grossmann, M. Asimow and S. F. Urban, Carnegie-Illinois Steel Corp., A.S.M., Convention Hall.

Automatic Carbon Arc Welding in the Automotive Industry, F. M. Maichle, Lincoln Electric Co.; *Use of Welding in Reconditioning Used Cars,* T. W. Moss, Chrysler Motors Service; *Welding Road Equipment,* Elmer Isgren, R. G. Le Tourneau, Inc., A.W.S., Italian Garden, Book-Cadillac.

3:20 P.M.

Behavior of Carbides as Affecting Hardenability, H. W. McQuaid, Republic Steel Corp., A.S.M., Convention Hall.

4:30 P.M.

Machineability of Tool Steels, educational lecture, A. H. d'Arcambal and W. E. Bancroft, Pratt & Whitney Co., A.S.M., Convention Hall.

7:00 P.M. ←

Annual dinner, A.W.S., Grand Ball Room, Book-Cadillac; W. I. Cameron, Ford Motor Co., speaker.

FRIDAY, OCT. 21

9:30 A.M.

Hardenability Tests, W. E. Jominy, General Motors Corp., A.S.M., Hotel Statler Ball Room.

Method for the Preparation of Metallographic Specimens, G. A. Ellinger and J. S. Acken, National Bureau of Standards, A.S.M., Hotel Statler Michigan Room.

All-Welded Steel Power Boats, M. Bailey, Bailey Steel Shipbuilding Co.; *Erection Sequence and Welding Procedure of All-Welded Lake Freighters,* Russell Brendle, Great Lakes Engineering Works; *Welding Coast Guard Vessels,* D. E. Whitehouse, Defoe Boat & Motor Works, A.W.S., Italian Garden, Book-Cadillac.

10:00 A.M.

Hardenability of Low Chromium Steels, W. Crafts and J. L. Lamont, Union Carbide & Carbon Research Laboratories, Inc., A.S.M., Hotel Statler Ball Room.

Automatic Polishing of Metallurgical Specimens Using Cast Iron and Lead Taps, T. C. Jarrett, American Optical Co., A.S.M., Hotel Statler Michigan Room.

10:40 A.M.

Transverse Hardness Tests of Heat Treated Steels, G. T. Williams, Cleveland Tractor Co., A.S.M., Hotel Statler Ball Room.

Metallographic Approach to the Study of the Sensitivity of Steel to Cold Work, H. K. Work and S. L. Case, Jones & Laughlin Steel Corp., A.S.M., Hotel Statler Michigan Room.

11:30 A.M. ←

A.W.S. business meeting and election of officers, Italian Garden, Book-Cadillac.

2:00 P.M.

Hardenability and Its Designation, the Hardenability Line, B. R. Queneau and W. H. Mayo, Carnegie-Illinois Steel Corp., A.S.M., Convention Hall.

2:40 P.M.

Hardenability of Plain Carbon Steels, J. L. Burns, Republic Steel Corp., and G. C. Riegel, Caterpillar Tractor Co., A.S.M., Convention Hall.

3:20 P.M.

Hardenability in Light Sections, G. V. Luerssen, Carpenter Steel Co., A.S.M., Convention Hall.

4:30 P.M.

Machining Nonferrous Materials (Cast and Wrought), W. P. Croft, Chase Brass & Copper Co., A.S.M. educational lecture, Convention Hall.

Flame Scarfing . . .

THE steel maker's hair shirt is bloom conditioning—for ten years a treacherous and extremely costly production bottleneck, it has been a recurrent castigation obviating possible smugness with an otherwise superefficient, mechanized, high speed evolution of steel from ore to warehouse. Millions have been spent and many a heart broken on this problem, all of which was groundwork for a spectacular new machine, a number of which have during several years quietly performed so creditably in the country's leading plants that the steel maker uncrossed his fingers, kept his mouth shut, and hastened to order additional machines. It's the Lin-De-Surfacer machine, an ingenious, high speed, mechanical device that continuously and accurately scalps a ***hot*** bloom of its faulty scarf skin, or epidermis, to expose an unblemished dermis that carries through the hot and cold mills with enhanced yield. Highly flexible, and therefore adaptable to practically any mill set-up, the Lin-De-Surfacer machine is sketched below in its most efficient position, on this side of the blooming mill shear, where the bloom is conditioned in one continuous, high speed operation as it passes along the roll table to the hot mill.

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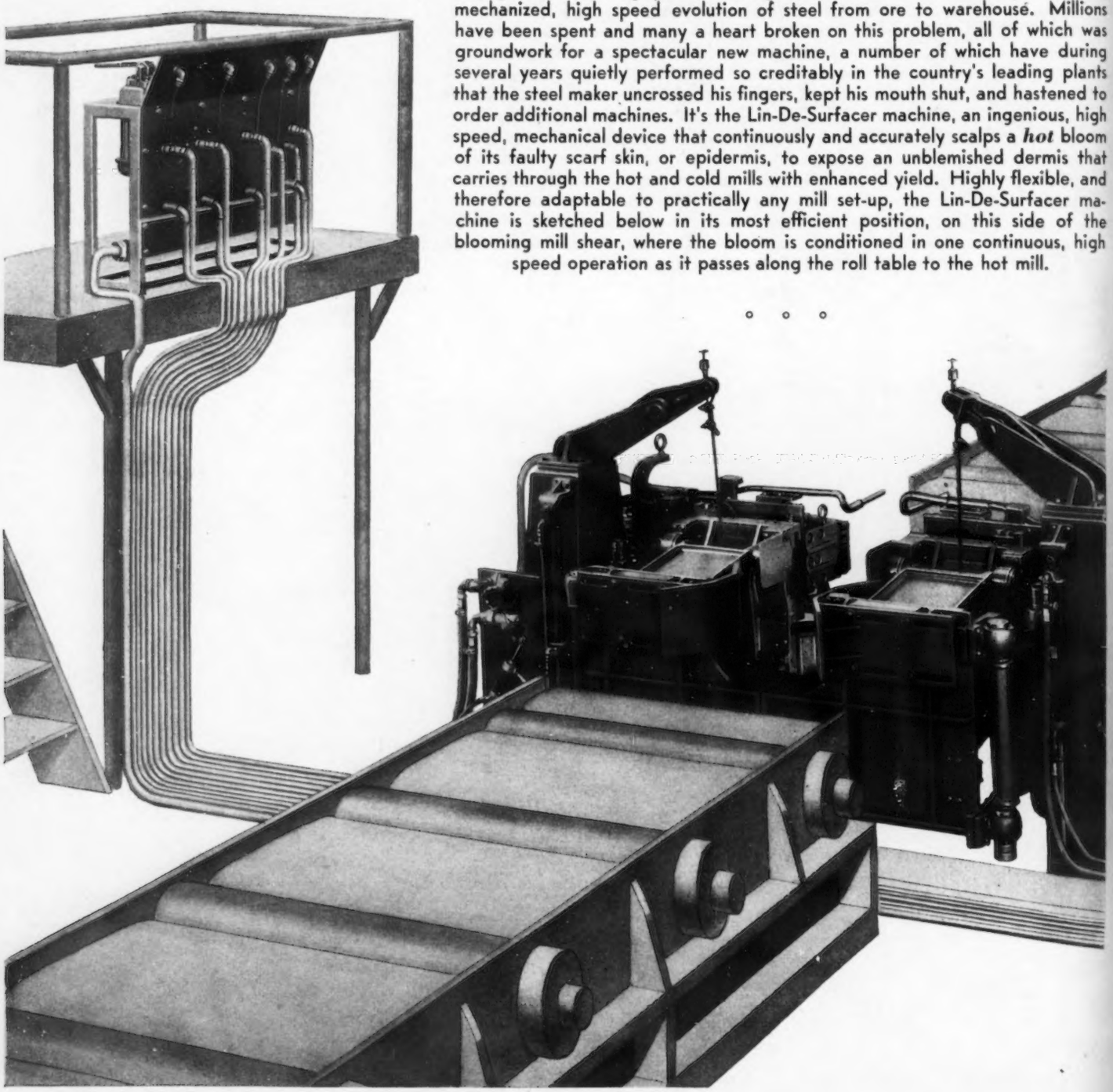
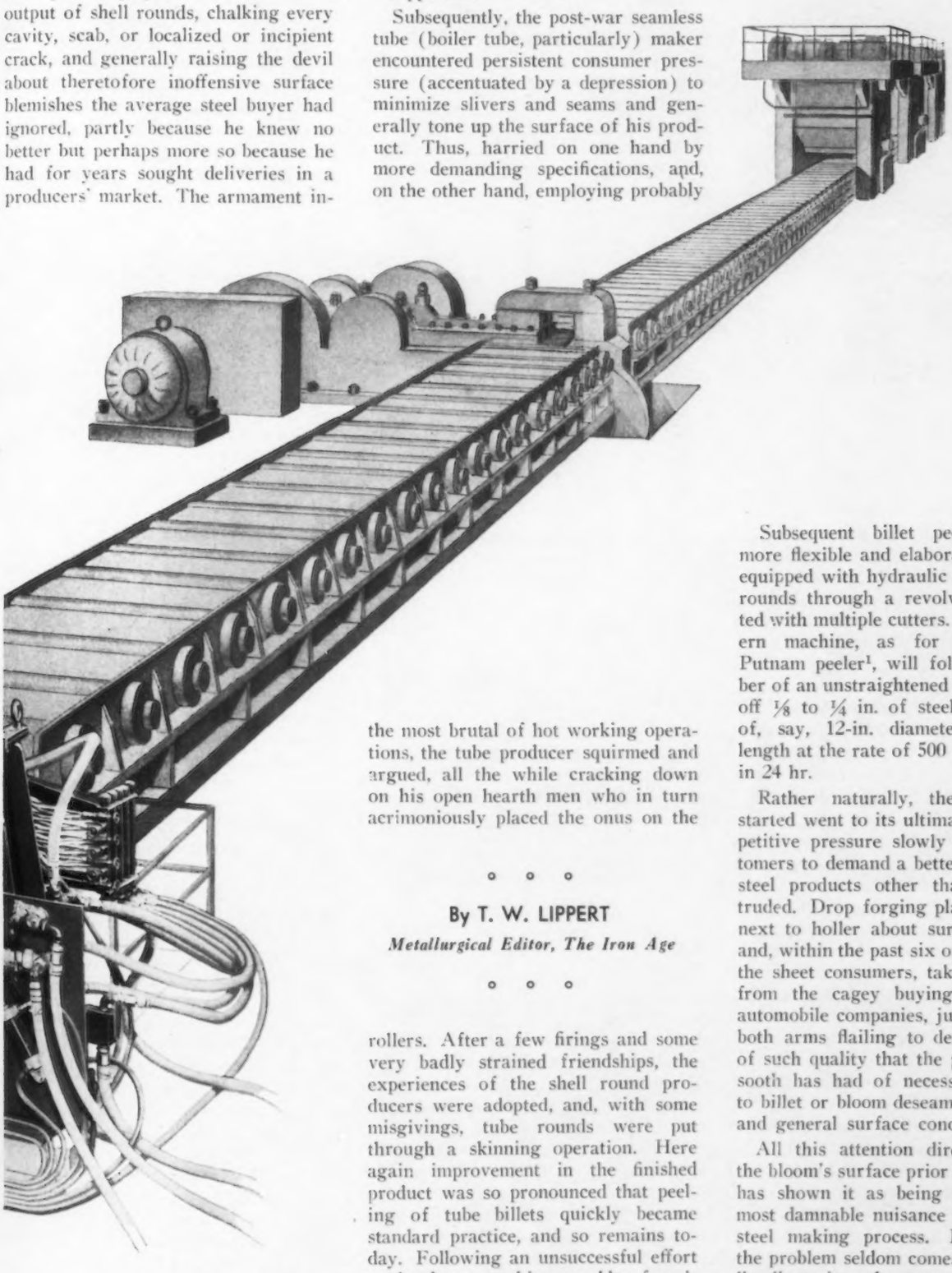


MORE efficient death set in motion the whole aggravating and costly chain of events. Captious government inspectors of the war period played havoc with the output of shell rounds, chalking every cavity, scab, or localized or incipient crack, and generally raising the devil about theretofore inoffensive surface blemishes the average steel buyer had ignored, partly because he knew no better but perhaps more so because he had for years sought deliveries in a producers' market. The armament inspectors kept pressing for improvement, advising meanwhile a removal of the bark from shell rounds. Steel makers finally capitulated, amid profuse profanity from operating and accounting departments, and, surprisingly, most of the surface blemishes disappeared.

Subsequently, the post-war seamless tube (boiler tube, particularly) maker encountered persistent consumer pressure (accentuated by a depression) to minimize slivers and seams and generally tone up the surface of his product. Thus, harried on one hand by more demanding specifications, and, on the other hand, employing probably the most brutal of hot working operations, the tube producer squirmed and argued, all the while cracking down on his open hearth men who in turn acrimoniously placed the onus on the rollers. After a few firings and some very badly strained friendships, the experiences of the shell round producers were adopted, and, with some misgivings, tube rounds were put through a skinning operation. Here again improvement in the finished product was so pronounced that peeling of tube billets quickly became standard practice, and so remains today. Following an unsuccessful effort to develop a machine capable of peeling hot billets, and thus save reheating costs, S. B. Sheldon, vice-president of Minnesota Steel Co., devised a rugged lathe to take the skin off cold rounds in one heavy, rough cut.



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By T. W. LIPPERT

Metallurgical Editor, The Iron Age

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Subsequent billet peelers became more flexible and elaborate, and were equipped with hydraulic grips to push rounds through a revolving head fitted with multiple cutters. Such a modern machine, as for instance the Putnam peeler[1], will follow the camber of an unstraightened round, taking off ⅛ to ¼ in. of steel from billets of, say, 12-in. diameter and 12-ft. length at the rate of 500 tons of billets in 24 hr.

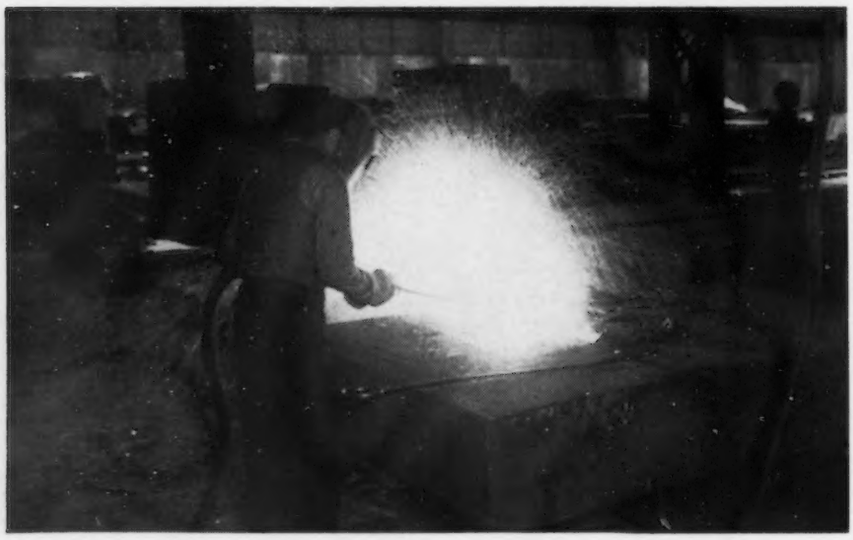
Rather naturally, the trend once started went to its ultimate end. Competitive pressure slowly brought customers to demand a better surface for steel products other than those extruded. Drop forging plants were the next to holler about surface defects; and, within the past six or seven years, the sheet consumers, taking their cue from the cagey buying practice of automobile companies, jumped in with both arms flailing to demand a steel of such quality that the producer forsooth has had of necessity to resort to billet or bloom deseaming, chipping and general surface conditioning.

All this attention directed toward the bloom's surface prior to hot rolling has shown it as being probably the most damnable nuisance of the whole steel making process. Even though the problem seldom comes up for public discussion, the costs involved are greater than the steel maker cares to admit, and the practice influences much of the profit possibilities of steel making, tied as it is so closely to balled-up production schedules and

[1] Niles Billet Peeler, THE IRON AGE, Sept. 19, 1935.

THREE conventional methods of conditioning the surface of semi-finished cold steel, all of which are hand operations, expensive, slow, and serious bottlenecks in the streamlined production methods of today. Above, the hand chipper bucks his pneumatic hammer to clean out a seam, and, below, the hard surface of alloy slabs are slowly ground down to uncover the clean steel underneath.

A HAND operated deseaming torch works its way across a slab (below). This practice, although much faster and generally cheaper than the two methods above, requires skillful manipulation and supervision.



reduced ingot yields, the latter even today averaging only 52 to 55 per cent for full finished autobody stock. Obviously, if bloom conditioning were to be made less costly or more accurate, or by the same token if yields were to be lifted by, say, 10 per cent, the result as reflected in the lower right-hand corner of the average steel company's ledger would be just as, or even more, spectacular than that credited to the much publicized continuous mill.

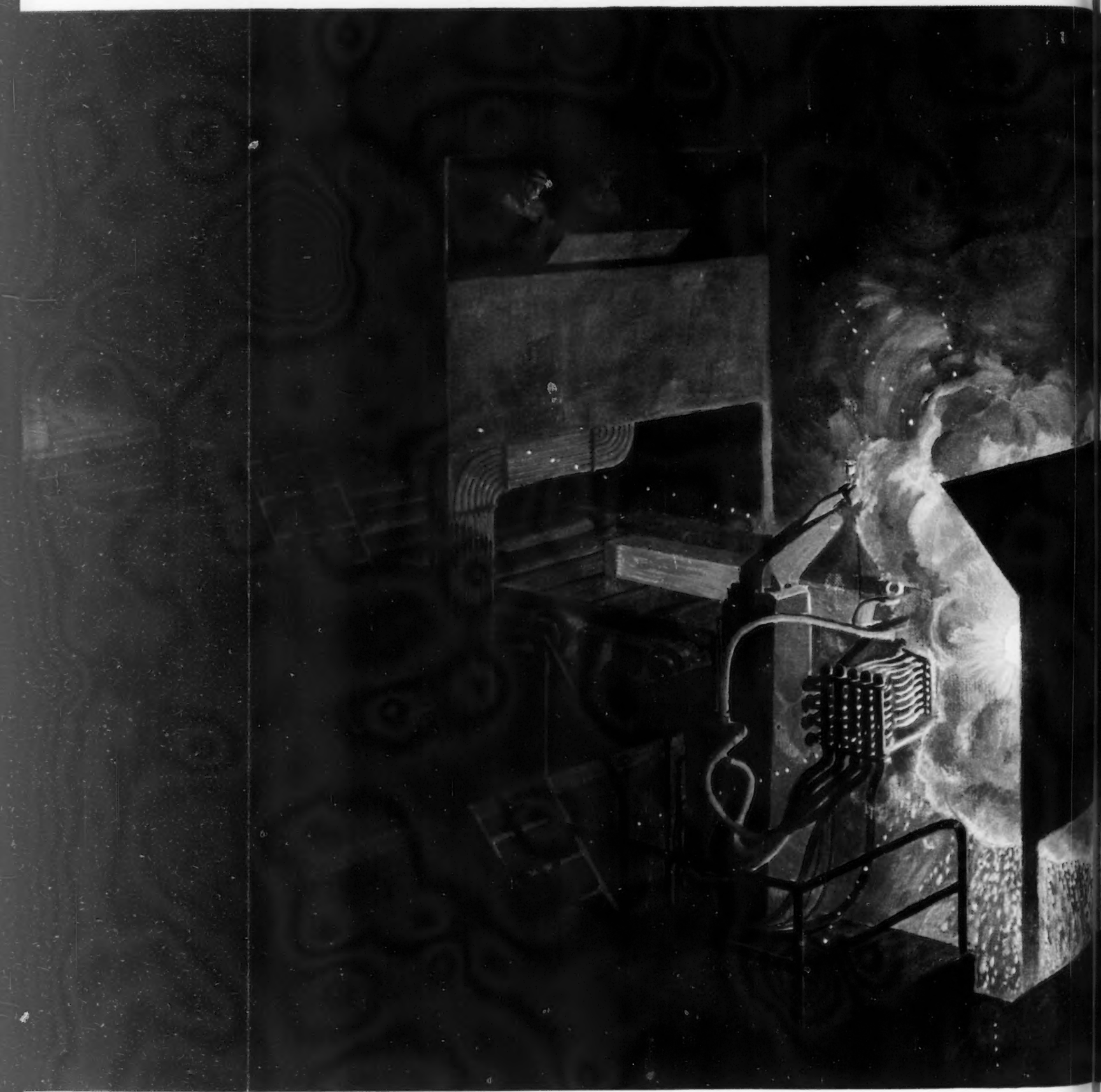
It's unfortunate that the whole subject of surface defects and attendant steel conditioning has bogged down into a muddle of exasperating consumer psychology, discouraging mutability, and divergent opinion, as exemplified in two schools of thought concerning mastery of the problem.

Regarding consumer psychology: It is apodeictic that bloom chipping troubles (and costs) are, oddly enough, inversely proportional to the volume of business. Make no mistake in thinking that mills running close to capacity suddenly turn out material requiring little surface attention—rather, it's traceable to delivery pressure and the consumer's concern with pushing his fabricated product into the market in jig time with little argument about quality, just so long as skin flaws are not too pronounced. This factitious situation undergoes a neat reversal during slack periods, however. Hard times breed chaffering, and amid yells to high heaven that living is impossible with such prices on one hand and cut-throat competition on the other, there develops a sudden finickiness about surface defects, finickiness literally approaching the imaginary in some instances. The consumer enters claims for adjustments and rebates, and in general keeps the selling pot at a high boil. So, the steel maker in hard times, just when additional cost is particularly burdensome, must bring back droves of chippers to hand manicure every pound of steel.

Today, the smart steel maker knows that chipping troubles will not only be a concomitant of lean business, but that the consumer will likely be in the driver's seat most all the time, what with steel capacity being bloated as it is. Thus, it is to him obvious that he can't walk away from his conditioning problem—he has to dig in and find a solution.

A ready solution has long seemed possible in view of the exasperating mutability of the surface problem. Not infrequently heats come on the run-out tables with skins as unblemished as that of a one-year-old baby. Just as likely the next heats from the same furnace, under practically identical mill conditions, bloom out as cracked

The Iron Age, October 13, 1938



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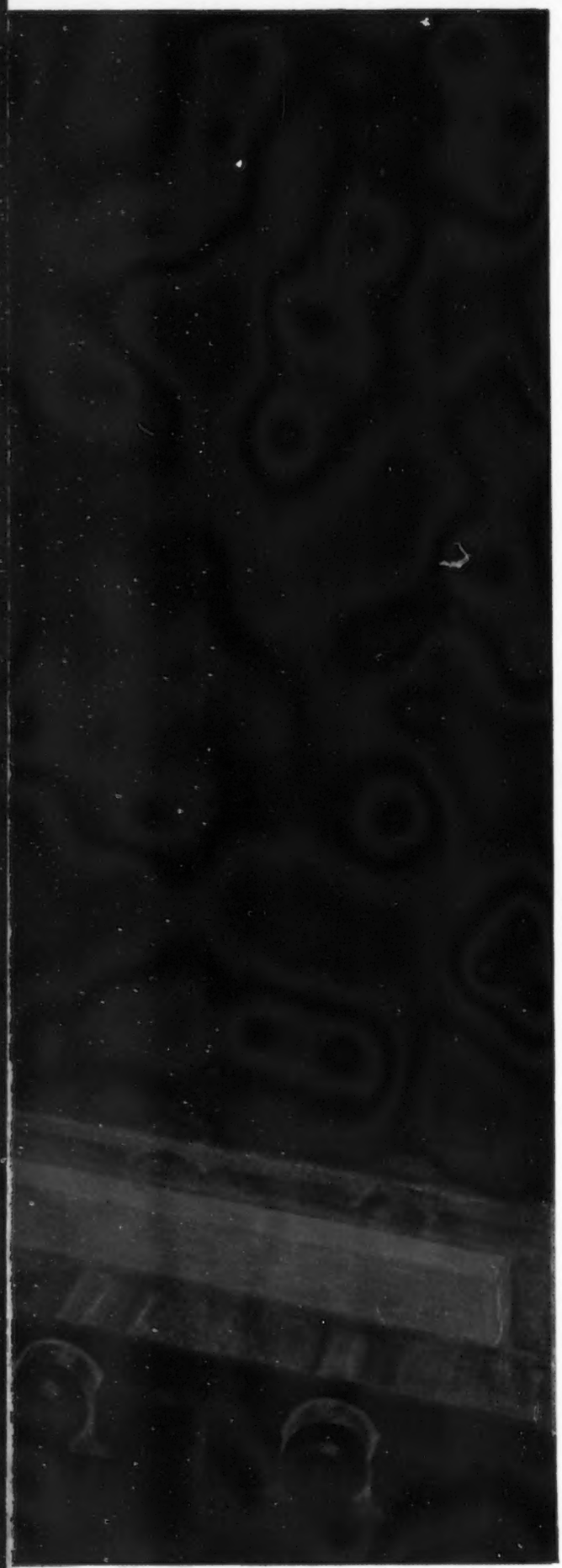

A DRAMATIC solution to the steel makers' most uneconomic operation—bloom conditioning. The Lin-De-Surfacer continuously scalps two or four sides of hot blooms, thereby permitting the long-sought and efficient "ideal" continuous flow of steel through the mill from open hearth to warehouse.

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and seamy as a bilious octogenarian. These occasional perfect heats raise hope for solution of the surface problem at the source, but it has been mostly a will-o'-the-wisp, serving only to emphasize the need for an ultimate solution at all times trustworthy and repeatable.

These diverging opinions, or two schools of thought regarding the most promising attack on the problem of surface imperfections, have with their mass of experimental data demonstrated the problem's ramifications and complexity. On the one hand, the metallurgist and chemist put their faith in preventative medicine, and stress the need for going back to the raw materials, tighten up open hearth practice, minimize variations in rolling mill drafts and speeds, schedule soaking pit temperatures to split-degree cycles, and confine the steel's cooling rate along carefully calculated curves. These studies are now getting on a sound scientific basis, and remarkable improvement has attended the investigations, but none the less the mill executive points toward even more rigid consumer demands, the continued need for mechanical surface reconditioning, its high cost, and the obvious economic loss entailed in the mill's inability to convert little more than half an ingot into high grade finished product. So the steel maker says more power to the preventative medicine men, but at the same time clutches any new procedure to mechanically dress the skin of his bloom or billet, realizing that the surface of his product can be no better than that of the bloom from which it is produced.

This article is concerned primarily with mechanized thermo-chemical bloom conditioning, and in particular the new and highly efficient Lin-De-Surfacer[2] machine, but the twistings and turnings and the contradictory results of the exponents of preventative medicine, the chemists and the metallurgists, are most interesting and well warrant passing atttention.

A major steel producer has whittled pencils to a fine point to go after element traces heretofore hardly suspected as present in a heat of steel, let alone exerting any significant influence. Laboratory preliminaries have even detected possible virtue in the addition of a jigger of silver to every steel heat, the likelihood being that if surface quality is improved on production schedules according to expectations the mill might well purchase (sic) a silver mine, use a little and send the remainder to the mint.

There has been a tendency for open hearth technicians to gallop off in many directions, as for instance ingot mold shape, ingot washes, teeming and pit practice, etc. A recurring controversy rages around relative efficiencies of square molds, fluted molds, corrugated molds, round molds, big-end-up or big-end-down molds, top and bottom pouring, basket pouring, stool design, rimming control or deoxidation practice, hot topping, or even the feasibility of using water cooled copper molds.[3] Admittedly some very helpful procedures have evolved, but much contradictory data lessen the possibility of a clear cut final answer to the problem of surface control. Many men doubt the possibility of completely eliminating ingot cracks, others admit that corrugated molds decrease cracking but deplore a reduction in service life and a difficulty in freeing such ingots of scale. Or, one shape of mold may reduce snakes (snakes are also a metallurgical responsibility, resulting from incipient hot shortness) but at the same time tend to lift the percentage of cold shuts, transverse fissures, surface tears from hanging in the mold, etc.

Still other investigators in the main discount mold design, placing emphasis primarily on studying the idiosyncrasies of a certain mold design and tightening teeming and pit practice to accommodate or take advantage of such idiosyncrasies. A clean pouring practice based on intelligent application of past experiences certainly can reduce scabs[4] and laps, and can have an influence on cracks developing in the forging or rolling operation, and can cut down on cold shuts; or a slip in teeming practice can result in a very thick or heavy wall, which in turn means that the ingot requires more

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REMOVED from its usual surroundings, the new Lin-De-Surfacer looks like this from the front. The two banks of blowpipes condition the two surfaces of a steel bloom continuously and at rolling temperatures.

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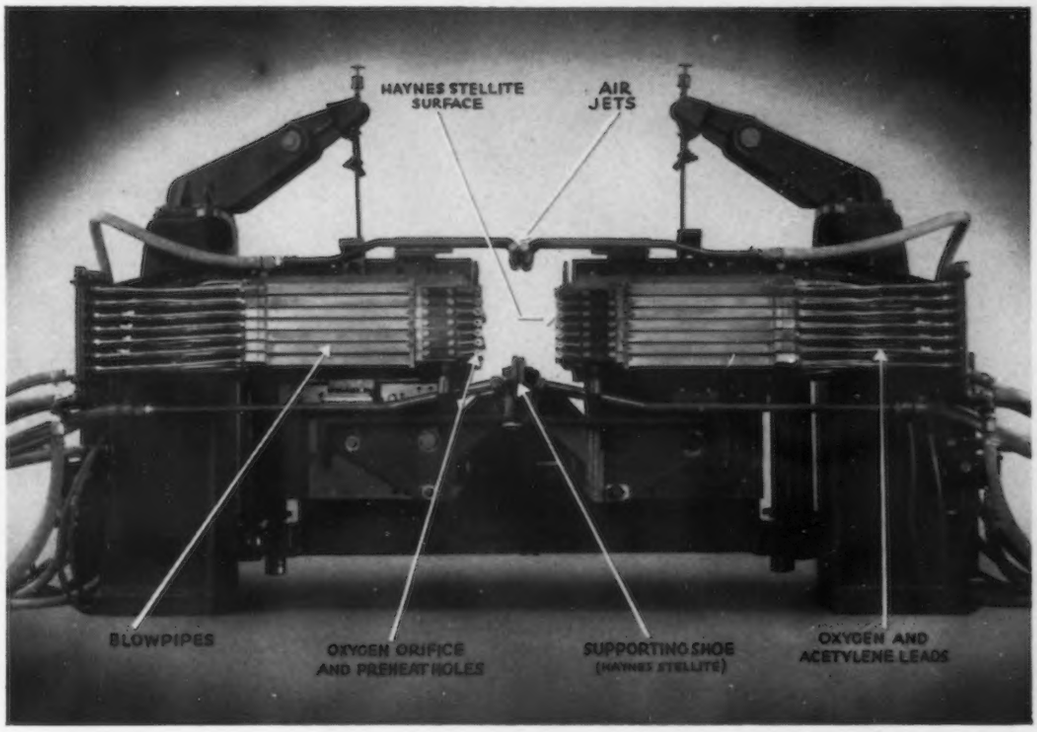

[2] Process and machines developments of The Linde Air Products Co., unit of Union Carbide & Carbon Corp.

[3] Dr.-Ing. W. Oertel, Willich, Germany; Iron and Steel Industry, February, 1930. Experiments on baby ingots in water cooled copper molds showed the surface as being clean and smooth.

[4] Here again responsibility may be traced to careless furnace practice, as for instance when a heat has had heavy bottom or bank boils; or scabs may also be purely a manifestation of essentially bad iron.

firing in the soaking pit, which in turn necessitates more air, and as the heatings become rasher the ingot becomes more bony and tends to break or tear in the rolling operation.

But, clean up pouring practice as he will, the open hearth man can at best today decrease the worst surface defects,[5] and in lieu of something better blames the remaining defects on the metallurgist or chemist, or on sloppy rolling mill technique.

Much attention also has been directed toward mold washes to tone up the ingot surface. Just about every pit boss at one time or another has concocted or sponsored some chemical goo to do the trick. Molds have been boiled in brine, sprayed with aluminum, doused with kerosene, dusted with bone ash, or liberally smeared with graphite or tar, all to conquer blisters, scabs, seams and cracks. Only tar and brine remain in favor, the former being far the more popular. Advocates of tar claim protection against splashes and numerous other attributes, but others ascribe to it a responsibility for blisters, hard spots, small blowholes, or a tendency to recarburize the surface. In any case, tar at best is a frail reed to lean upon, requiring constancy in chemistry, temperature of application, thickness of coating, etc.

All the foregoing history of the ramifications of attempts toward surface control certainly emphasizes the determination of open hearth men to accomplish one thing—to cut the cost of or eliminate surface conditioning. It has kept the open hearth men stewing in their labors for years, only to toss the responsibility to the rolling mill men as often as possible, forcing the latter to cover their furnaces with thermocouples, dissect firing fuels and evolve elaborate correlations between drafts and speeds; then the rollers in desperation shift the problem back to the chemists and metallurgists, and while they are going their careful, detailed way the brass hats put the pressure on everyone indiscriminately in proportion to consumer criticism and volume of murmurings from the accounting department.

The exponents of preventative medicine in their worrying over the problem have indeed gone a long way in clearing up the sources of trouble. But, even after all this work, most mills find yet, and are likely to so find for many years, that the chipping and hand scarfing bays (or, some equally effective substitute procedure) are their only sure control of the situation, and producers continue to sweat under an uneconomic 50 to 60 per cent yield on their higher grade ingots, and fret with drastic swings in bloom conditioning, swings ranging from 50c. to $8 a ton, with averages unfortunately pressing the higher figure rather than the lower.

It's no wonder then that those who view the problem as secondarily one of preventative medicine and primarily one of cutting out defects after their appearance have jumped all over the map in their search for improved efficiency in preparing blooms for the rolling mills. The history of these attempts shows a series of disappointments—it's a history that forcibly demonstrates that a manufacturing practice is so frequently one of cut and try, of rule of thumb, of a combination of blind guess-work and careful analyses. It shows how such a successful final attack on the problem as the Lin-De-Surfacer machine had in its turn to await a development in an entirely different field, that is, an efficient and economical means for providing pure, dry oxygen at a high instantaneous demand rate of supply.

Early in this article the original practice of peeling tube mill rounds was mentioned. And as the pressure for improved yield and better surface spread out to the drop forging stock and the multitude of flat rolled products, there followed a whole cycle of frantic attempts to mechanically condition all the semi-finished steel involved.

Blooms were then and still are cooled, then pickled (at a cost from 16c. to 35c. per ton) so that inspectors could more easily spot and chalk every crack, seam, snake, blister, cold-shut, and scab, the bulk of which were found to extend little more than 1/16 in. to ¼ in. below the surface. The pneumatic hammer was brought into the mill, fitted with hard chisels, and crews of men set to work laboriously gouging all the defects. Two or three months were required to train an efficient chipper, and swings upward in mill activity necessitated quick expansion in crews, the new men operating most wastefully or at low speed. Chippers, subject to continual vibration of the tool, usually were good for such work for only several years, and there was general difficulty in conditioning hard alloy steels and gouging deep seated defects. There can be no denying that hand chipping was and is a slow, expensive and unsatisfactory method of conditioning, and exists only because the producer has for years seen nothing better to switch to.

But it didn't take a lazy man long to figure out that flourishing an oxy-acetylene cutting torch used by riggers around the mill was a far more easy method of removing defects than bucking a chipping hammer all day. These early torches of course were designed for shearing or sharp line performance and were inefficient peelers or gougers. However, torch makers were quick to grasp the problem and there followed a whole epidemic of torch tips, flame shapes, pressure controls, etc., all designed to more quickly and satisfactorily burn out bloom defects.

Several early efforts, however, were battered on the rock of high cost of bottled oxygen and acetylene, which in turn influenced a whole series of attempts to use oxygen with natural gas or coke oven gas as a substitute fuel, and a multitude of torches were devised to handle the less efficient, low heat intensity fuel gases. These experiments helped to span the gap until the present low priced oxygen and generated acetylene distribution systems were made available to the steel companies. As a result, the average steel conditioning cost in the United States today is judged as being appreciably lower than it was only a few years ago, since considerable hand torch scarfing (or deseaming) is being done.

There followed a period when the machine tool builders decided to take a shot at the problem, and came into the market with numerous intricate universal-jointed millers and gougers, the underlying idea always being to devise a cutting tool mounting that could be manipulated in three dimensions at a twitch of the operator's finger, so that a snake could be chased all over the bloom surface, a corner crack be chamfered, a blister shaved off, or a seam explored. Of the several general disadvantages of these machine tools, the most pronounced was dimensional limitations, although slow speed and costly operation served to kill off many. For instance, if a machine were made big enough for a slab it was too cumbersome for a billet. It was also true that some of the machines were so deadly flexible that the operator could gouge steel with the ease of picking his teeth, the result being that many an expensive ingot ended up mostly as chips, and the skinny, crooked piece of metal finally sent to the rolling mill was often not much more than a chip itself.

Out of the ruck of slab milling ma-

[5] P. S. McKimm, of Otis, in the Open Hearth Conference of 1937, reported no slab conditioning for 6½ years because of a tight melting and teeming practice. His statement cannot be considered representative of the industry, however.

The Iron Age, October 13, 1938

A SPECTACULAR and efficient new unit for America's cont
ous mills. The Lin-De-Surfacer at high speed removes
scabrous skin from the two sides of this hot bloom to a depth
1/8 in. to 1/4 in., according to the surface condition of each i
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chines,[6] semi-vertical millers, clapper box planers, and combined revolving and planer heads flooding the trade at that time, only the latter has survived to turn in a performance justifying its existence. A number of these are now scattered around the country.[7]

Following the reign of machine tools, a phase in bloom conditioning evolved which might well be termed psychological. Steel makers decided the wrong workers were conditioning the steel, that the open hearth or pit men making the ingot were not versed in the fine points of steel surface and thus were inclined to gouge and cut away minor imperfections, fly specks, tobacco juice and all other incidental surface markings. Rather, it was decided that rollers were more qualified to judge what was wanted and therefore condition more intelligently. Therefore, the responsibility was relegated to them. This was a wise step, and there followed some minor niceties, such as special cranes to manipulate the blooms in conditioning docks, more skilled supervision of operators following inspector's markings, etc.

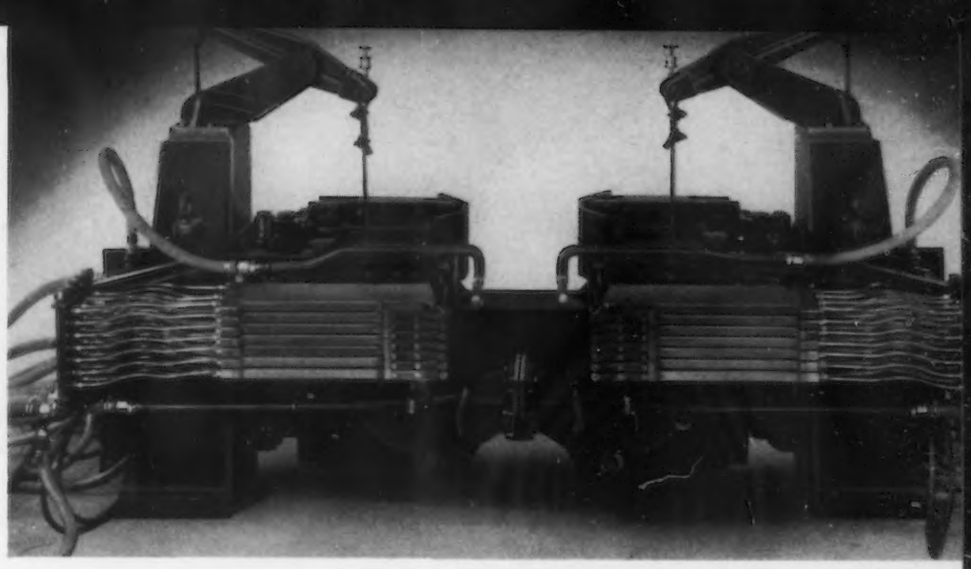
Scattered throughout all this work was the somewhat abortive effort of the makers of grinding wheels to transplant the old foundry swing grinder to the steel mill. Blocks were put on the floor and cleats on the workman so that he could get a good push, and the wheels were set to grinding out the cracks, seams and the varied imperfections. This practice pretty well blew up on the incapacity of the wheel to go after deep seated defects without wasting time and metal. The grinding wheel has survived in the alloy field, primarily because the blooms are smaller, the metal too hard for cutting tools, the surface generally far better to start with than for carbon steel, or torch deseaming on cold metal inadvisable in view of air-hardening characteristics of the alloy.[8]

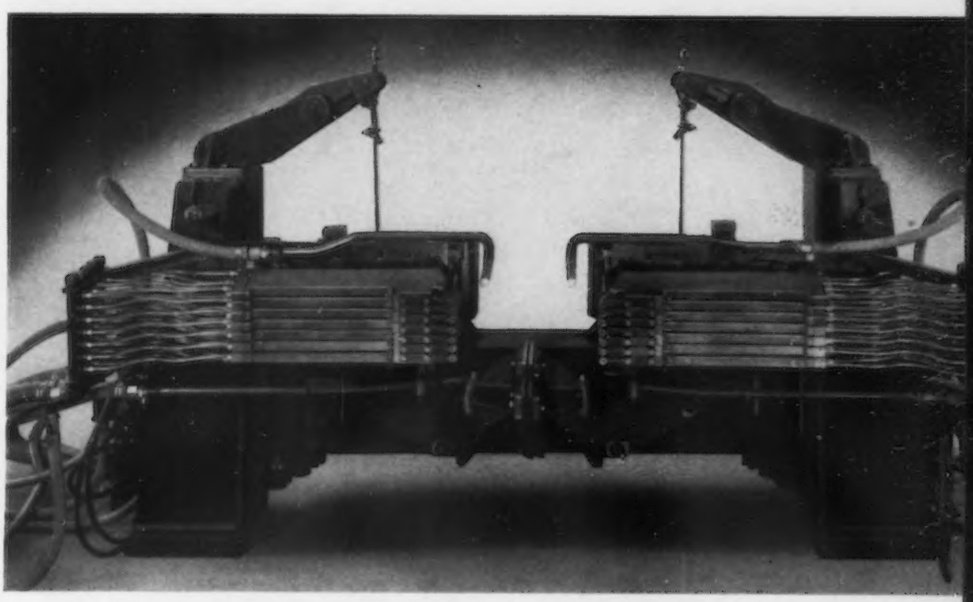
So, all this labor brings the problem down to the present time, where torch deseaming is employed in some plants, but with many steel makers retaining the original bucking pneumatic ham-

[6] Milling machines never were popular for steel conditioning, but have long been a standby for scalping copper and aluminum billets. For instance, copper billets are rolled to ¼ in. thick, and scalped in special machines using regular spiral cutters varying in diameter from 4½ in. to 10 in. and up to 12 in. or 24 in. in length. The high speed steel cutters up to 18 in. long are in one piece, over that length they are sectional. About 0.015 in. of copper is scalped off, the cost varying from ½c. to ¾c. per lb.

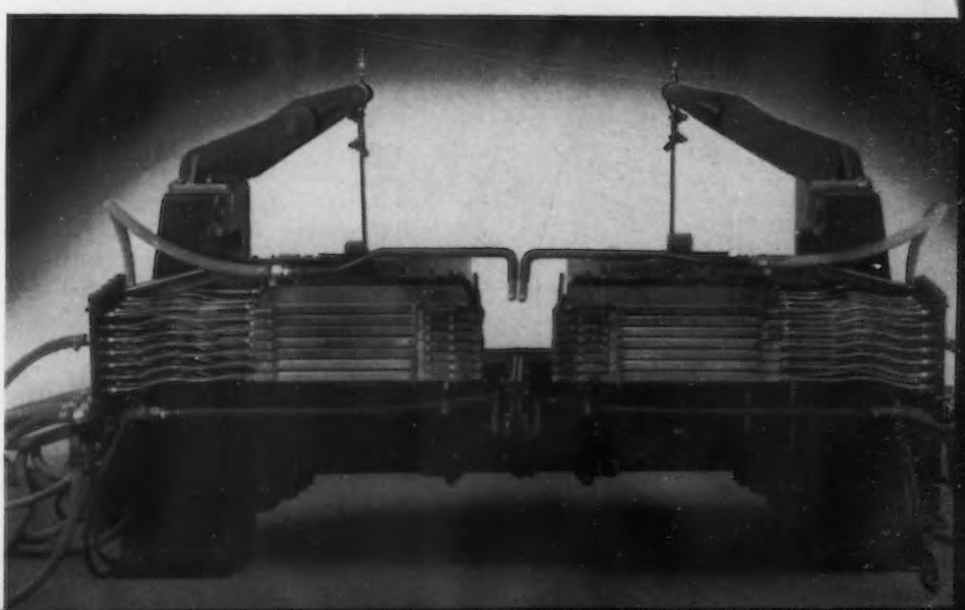
[7] Bonnot-Lentz Billeteer, THE IRON AGE, Sept. 27, 1934.

[8] For example, stainless steel billets on grinding involve a metal loss of 6 to 10 per cent and a cost of, say, $15 to $20 a ton. Free machining 18-8 requires double converting, the grinding cost being, say, $25 to $30 per ton, the weight loss being well over 10 per cent.





THREE steps in the normal operation of the new steel conditioning machine. That pictured above shows the two banks of blowpipes mechanically lowered and spread apart to receive the bloom. The view below indicates how the blowpipes are raised and under-guide shoes bear against the underside of the bloom.



THE third operation, below, shows the two blowpipe units moved in against the sides of the bloom. Preheating gases and desurfacing oxygen are turned on in succession, and the bloom starts to pass through the machine at a speed of over 100 ft. per min.

mer, and the alloy plants cleaving to the grinding wheel.

All the costly experimentation, and the elaborate hit-or-miss trials have accumulated a mass of data, the bulk of which has dramatically pointed to the necessity of a drastic forward step in conditioning, a necessity for a machine or practice that should have the following characteristics:

(1) It should be fast, accurate and continuous, and in no way interfere with the flexible production cycles. In this manner steel inventories may be reduced and production better adjusted to fluctuating demands.

(2) It should involve personal skill or the human element as little as possible.

(3) It need only remove imperfections in the outer ⅛ in. or ¼ in. of surface and thus conserve metal; the metallurgists, chemists and open hearth men have pretty well mastered the causes of more deep-seated defects.

(4) It should "ideally" detect or remove incipient cracks or seams, or all subcutaneous defects that the eye of the average inspector would pass over.

(5) It should condition the bloom while hot, preferably on the roll table at rolling heat, and thereby save sizable reheating costs and reduce investments in furnace equipment.

(6) It should be completely flexible, i.e., flexible as regards handling different steels in different ways, and flexible in that all sizes of steel can be handled, from narrow blooms up to wide slabs.

Well aware of these necessary requirements, and also well aware of the drastic need for plugging this very weak spot in the metallurgical art of today, the makers of cutting gases several years ago sketched possible machines for handling hot blooms. One such firm was Linde, which had perfected the Driox oxygen system as an efficient and economical source of pure, dry oxygen. With this system great quantities of oxygen can be delivered in the liquid phase occupying comparatively little space. This liquid oxygen, shipped in special tank trucks and stored in insulated containers, on usage returns to the gas phase as quickly and at any desired pressure the demand requirements necessitate, no matter to what degree they may fluctuate.

After the construction of several pilot machines to facilitate research and development experiments, Linde turned out a machine that incorporates not several of the foregoing six "ideal" characteristics, but apparently covers all of them. And months of subsequent plant operation under full production conditions have shown that in this machine, the Lin-De-Surfacer machine, the steel maker has at hand a means to clear up the bulk of troubles of the past, and, what's more, clear them up in a comparatively inexpensive and efficient manner.

Five detailed pictures of the Lin-De-Surfacer machine are shown for the first time with this article, and the two accompanying four-color inserts dramatically illustrate one of these spectacular machines in operation.

At first glance, the flame scarfing machine could possibly be considered an elaborate arrangement of many individual cutting torches. Such is not the case. The entire action is different from cutting, the torch design being radically changed, gas velocities being far lower, and the slag produced so different as to indicate a far different thermo-chemical action taking place.

The Lin-De-Surfacer machines are built to withstand the hard usage required of steel mill equipment, and operate under the high temperature conditions prevailing in the rolling of steel; or they can be used on cold steel. They are very flexible in design, which makes them adaptable to the conditioning of blooms, billets, bars, sheet bars, and even semi-finished shapes.

As shown in the accompanying illustrations, a typical machine carries two or more banks of blowpipes which remove 1/32 in. to ¼ in. (or, of course, more if need be) of metal from two or more opposite surfaces simultaneously. The depth of removal depends upon the nature of the surface defects, and is under complete control of one operator who may vary oxygen pressure and operating speed, the latter ranging from 50 to 175 ft. per min., a speed which lends itself to coordination with mill rolling speeds.

The machine can be installed at any convenient point in the rolling mill production line. It can, for example, be located either ahead of or beyond the shear to condition two vertical surfaces of steel or, except on *wide* slabs, all four sides simultaneously. Hot steel coming from the blooming mill passes through the shear, and then through the machine, where it is conditioned without interrupting production. Where only two sides of a bloom or billet are desurfaced simultaneously, the hot steel is passed through the machine twice, and it is given a quarter turn between passes, or, alternatively, two machines can be set up in series with a manipulator between, and two parallel surfaces can be conditioned by each machine. In the case of slabs, the procedure is essentially the same, except that two contiguous sides (instead of two opposite sides) are desurfaced simultaneously.

The four-side Lin-De-Surfacer machine has been designed to condition four sides of the bloom simultaneously. The picture of this machine on the opposite page shows that the bloom passes through on the diamond, although a square pass offers no problems and may be used. Each right-angle unit of blowpipes moves as a group, the two right-angle assemblies floating independently on counterbalanced air cylinders and a pantograph assembly, the result being that a twisted bloom or a hooked end is followed with facility, the torches taking off the skin at a uniform depth throughout. In the four-sided machine there is no hard-surfaced shoe for the bloom to ride on, but rather it is supported by hard-surfaced ribs on the faces of the four blowpipe units, which are forced into intimate contact with the bloom surface.

From the standpoint of popularity the four-side machine is the type most appealing to the steel man. It is quite true that from the standpoint of changing of banks of blowpipes, the two-side machine is easier to handle and in the past the use of the four-side machine has been recommended in cases where only occasional changes of banks of blowpipes would be necessary. However, circumstances such as insufficient space in mills for turning blooms, billets, etc., and the time cycles involved where such turning is necessary often necessitate the installation of four-side machines even where frequent changes of blowpipe banks are necessary.

But, so far the two-side machine has been used mostly, and thus will be considered in more detail. Such a typical unit, shown on page 47, has two banks of blowpipes which apply the preheating and desurfacing gases to the steel. Each blowpipe has individual supply lines for preheat oxygen, preheat acetylene, desurfacing oxygen and cooling water. The four compressed air jets, two above and two below, prevent molten slag from coming in contact with and adhering to the two surfaces not being conditioned during the pass. Below, there is a hard-surfaced shoe on which the bloom rides, and there is also hard surfaced (Haynes Stellite alloy) boxing completely protecting the ends of the blowpipes and which absorbs the wear as the desurfacing units are pressed tight to the side of the moving bloom. The entire machine can be unbolted in the middle and expanded by adding frame sections, so that wider steels can be

accommodated; or the blowpipe units can be easily and quickly removed, which facilitates changing over to a unit having a larger or smaller number of blowpipes to accommodate various forms and thicknesses of steel. Each bank of blowpipes moves independently of the other; each is full-floating, both horizontally and vertically, so that they both remain in correct alinement with the bloom at all times, thereby assuring that a uniform thickness of metal is removed.

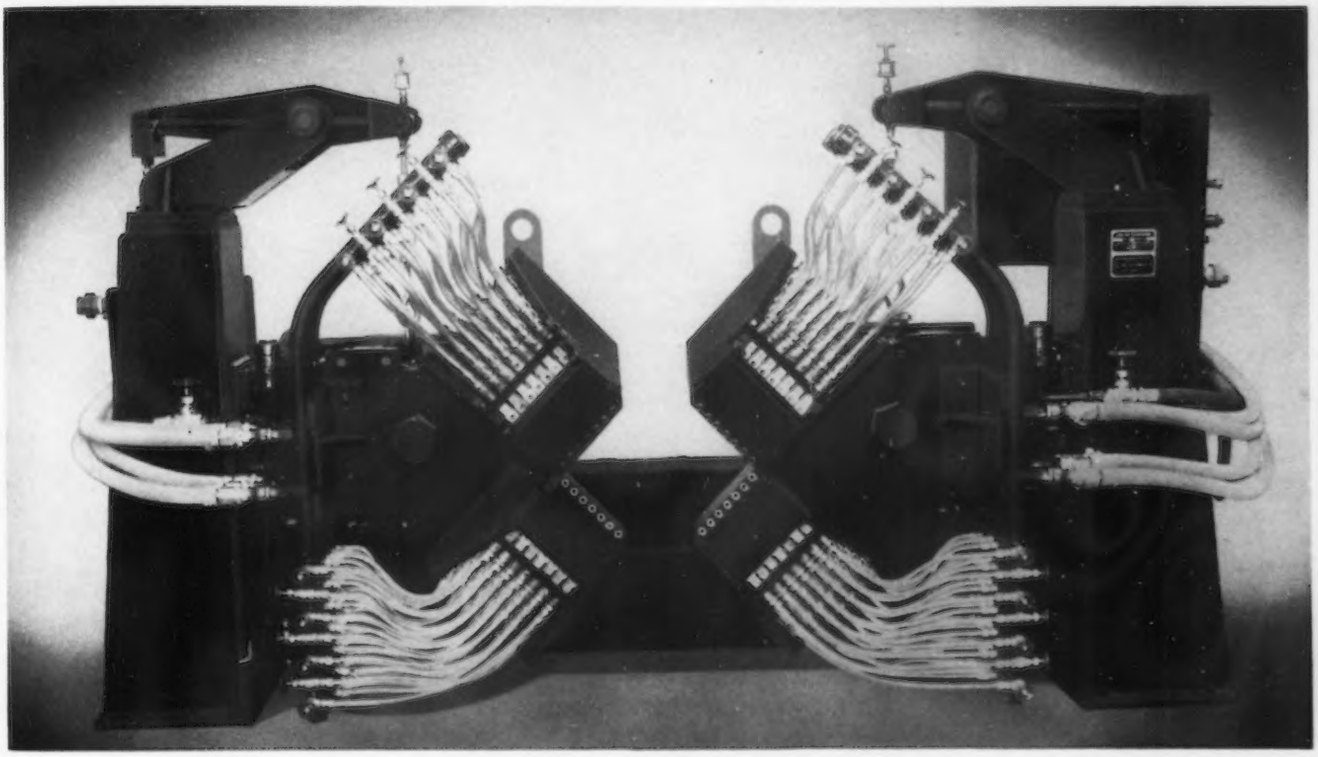
A conventional location for the desurfacing machine is just beyond the blooming mill shear, although there is such variation in mill set-ups in this country that each installation must be individually designed to accommodate space and operating requirements. The roll table has been cut and a section removed in the sketch on page 40, and the conditioning machine placed in the space so provided. In one installation, the entire machine is carried on an overhead support with no interference with the roll table whatsoever, and in another mill the machine is mounted on precision ways to move into place for certain blooms and move out of the roll table when other sizes come through.

The three steps in normal operation of the machine are shown on page 51. The top view shows the blowpipes mechanically lowered (by controls in the operating pulpit) and spread apart prior to entrance of the bloom into the machine. The operator controls the roll table as the bloom enters the machine, the blowpipes are raised so that the hard-surfaced under-guide shoes bear against the underside of the bloom (middle view), and then the blowpipes are moved against the sides of the bloom (lower view). The operator may jiggle his controls a little to exactly position the bloom, after which he turns on his preheat gases. In about 2 sec. the desurfacing oxygen is switched on, which automatically starts the roll table to move the bloom forward. And, amid as spectacular an operation the steel mill has ever witnessed, the bloom has its skin lifted off in a multitude of shallow grooves. At the end of the pass the operator cuts off preheat gases, oxygen and relinquishes control of the roll table. Interlocking roll table controls give control of the table to either the shearman or the Lin-De-Surfacer machine operator, the former in control (at a speed of, say, 400 ft. per min.) at all times other than when the bloom is approaching or actually in the machine, at which time the machine's operator is in complete charge of the bloom's movement.

Working on a hot bloom, at a temperature of about 1800 deg. to 2000 deg. F., the preheat gases take the steel up to the point where it is ready to drip (2600 deg. F.) in about 2 sec., after which the oxygen blast slicks off the surface at speeds of well over 100 ft. per min. It's this ability to handle hot steel that makes the Lin-De-Surfacer machine particularly efficient, as preheat gas consumption is comparatively negligible, time is saved (a preheat on cold steel would take from 5 to 15 sec.), there is actually an increase of surface temperature,[9] reheating costs are thus eliminated and, the need for expensive reheating furnaces reduced.[9]

In all the pictures of the machine shown herein, the bloom moves into the paper, that is its direction of travel is against that of the desurfacing flame, as would be expected. Note the large desurfacing oxygen orifice, one of the major differences between this blowpipe and the conventional cutting torch. The oxygen velocity is very low, on the order of rivet cutting velocities, whereas ordinary cutting torches use velocities much higher. The tiny preheat holes encircling each oxygen orifice cannot be seen in the pictures; the preheat gas mixture is

(*Continued on page 81*)



THIS type of Lin-De-Surfacer has compound blowpipe units designed to condition four sides of the steel simultaneously. Counter-balancing and a pantograph assembly assure constant contact with the steel's surface.

[9] One mill found a 200 deg. F. lift in surface temperature after surface conditioning. This increase (on a bar mill) resulted in their rolling a longer bar, as previous practice required cutting the bloom in half and holding back the second half for reheating. Another mill previously ran three reheating furnaces at all times during regular mill operation. Since the flame scarfing machine has gone into operation, two of the furnaces have been shut down.

Metal

PRODUCTION

STEEL is the sinew of machines, and the machine frequently is censured as the destroyer of beauty and the degrader of civilization. Admittedly, the machine of 50 years ago itself was ugly, and all too often its product an eyesore. But skilled hands have rebuilt the machine, and in this more cushy era it is the creator of beauty; beauty at a cost ludicrously small for the homes and lives of millions of people who never before in history could lay claim to a single mechanical object with an esthetic appearance. But steel can face esthetics with double pride; for not only is it representative of the machine, a creator of beauty, but in production is itself beauty. Be it in a costly maze of continuous mill machinery or the lowly foundry crouched smokily alongside the railroad tracks, none of man's triumphs can surpass steel making as a spectacle. But as representative of all the heritage of steel making, combining the perfection of form resulting from the harmonious combination of grace, skill, labor and color, the hand operated, looping bar mill, as shown opposite in the Driver-Harris Co. plant, stands as peer of all the steel maker's art.

Fundamentals of Wire Drawing

By F. C. THOMPSON, D.Met., M.Sc.
Victoria University of Manchester, England

AN account will be given herein of the main results of some ten years of research work on the fundamentals of the wire drawing process. Although nothing very new can be presented, practically all of the work having been previously published in the Journal of the Iron and Steel Institute and the Institute of Metals, an attempt will be made to correlate all the isolated reports into a sensible whole.

It can be shown from a study of the dimensions of the factors involved that the power required to draw a wire is directly proportional to the speed of drawing, to the elastic limit of the original material and to the area. Many other factors of importance such as the temperature, the reduction of area effected by the pass, the angle and contour of the die, the coefficient of friction of the lubricant used and the space-lattice in which the material crystallizes, although of supreme importance, are non-dimensional and cannot, therefore, be considered in this way.

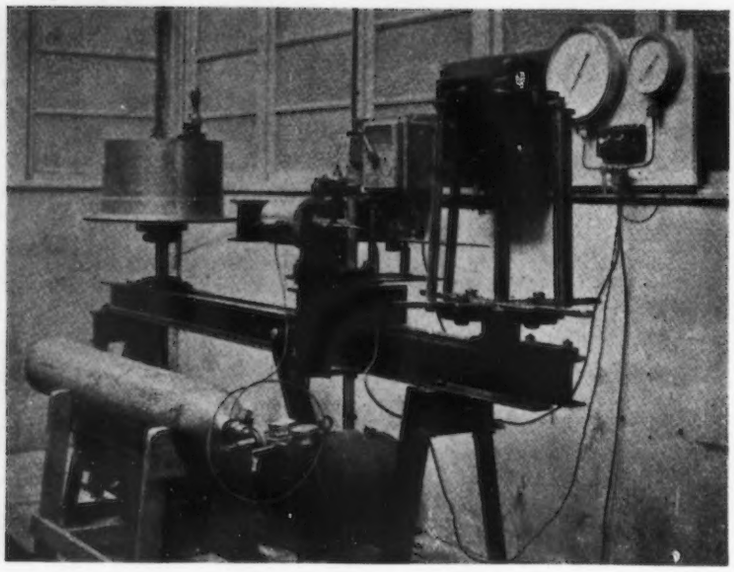
In the experimental work carried out, two pieces of apparatus were designed and employed. In the first of these the pull was applied by a dead load by a cable passing over a double pulley. As the wire was drawn through the die, the rotation of the pulley caused another cable to move and so to actuate a pen moving down a board which had a simultaneous horizontal motion. As a result a curve was traced, the tangent of which represented the speed of drawing. As will, however, be shown later, such apparatus may lead to results which are far removed from those which obtain at commercial speeds.

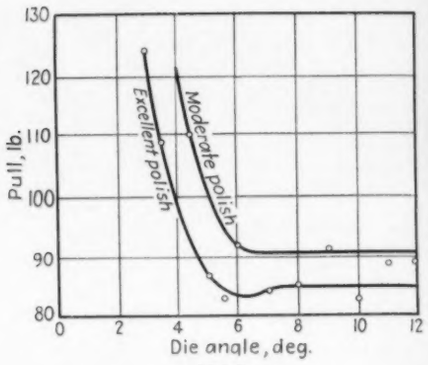
Speed Effects

The second apparatus, Fig. 1, with which the majority of the results which will be considered here were obtained, consisted of a strong horizontal arm pivoted about its center. To one end the die was attached, while the other was actuated by a plunger whose movement was determined by the pressure of air in its cylinder. The tendency of the arm to move under the traction due to the drawing was neutralized by the plunger until an exact balance was obtained as determined by two electrical contacts. When this state of affairs prevailed, the pressure of the air in the cylinder in pounds per square inch was one-tenth of the actual pull on the die in pounds. Speeds of drawing up to 600 ft. per min. were obtained with this machine, above which there is no reason to suppose the actual fundamentals of the process are appreciably modified.

As will be noted from the dimensional treatment, the actual pull (not the power required, which is a linear function of the speed of drawing) is independent of speed. This rather unexpected result has been completely confirmed over the range from about 20 to 600 ft. per min. At very low speeds of drawing, such as have been used in some researches, however, this independence no longer holds and the pull goes up as the speed of drawing is raised. In Fig. 2 are shown some of the results at the higher speeds and in Fig. 3 the effect at very low rates of drawing. It is clear that research to be of value must be carried out somewhere in the higher speed range. This will be confirmed later when the results of rotating the die are considered, when it will be shown that totally different effects are to be found according to whether the drawing is done at low or at higher velocities.

From the point of view of the pull needed to effect a given reduction then, the matter of speed is unimportant; a result which is not in accord with some English practice where in the drawing of high tensile wires for ropes, etc., it is usual to restrict the rate of drawing to something of the order of say 300 ft. per min. The explanation given for this is that when drawn at higher speeds the wire tends to undergo a form of age-embrittlement due presumably to the attainment during drawing of a temperature in the "blueing" range. Experiments carried out to determine whether this





ABOVE

FIG. 4—Influence of the die polish on pull required for drawing.

o o o

AT LEFT

FIG. 1—Drawing equipment for determining the pull at speeds up to 600 ft. per min.

argument had any substantial foundation have shown that the strength of the wire as drawn, and after aging for over six months, is in all cases, whatever be the carbon content of the steel, quite independent of the speed of drawing, at any rate up to the limits adopted in this work. It must be admitted, however, that the research did not consider the impact value of the wires and that there is still uncertainty from this point of view. There has, however, in recent years been a marked tendency to raise the speed of drawing with, so far as can be ascertained, no harmful result.

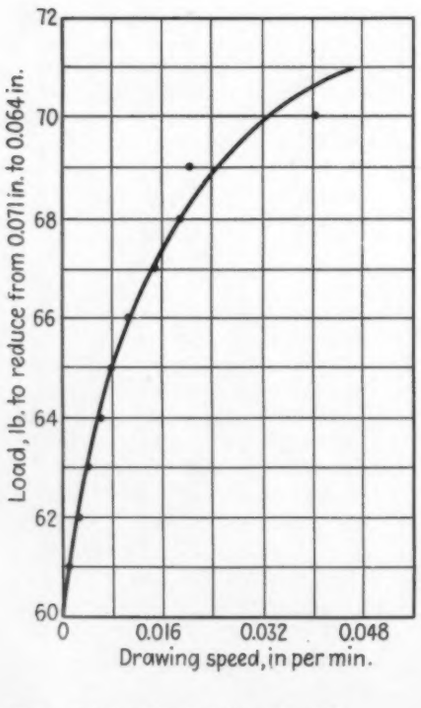
Dies of three different materials have been used; viz., high carbon and chromium steel, sintered tungsten carbide and diamond. With regard to the steel dies, it has been shown that the pull required is higher than that needed to effect the same reduction with a tungsten carbide die. In some cases this difference is most marked.

Influence of the Die

As an example, which is typical of many which could be quoted, the pull to draw 70:30 brass wire down by 21 per cent, using a constant soap solution as the lubricant and a die angle of 6 deg., was 8 lb. for the steel die, as against only 51 lb. for the carbide die.

With diamond dies the author's experience has been more limited, but the following set of determinations, made in drawing 80:20 cupro-nickel wire down 20 per cent, under identical conditions of speed, lubricant and die angle, show the effect clearly. Using the carbide die a pull of 44 lb. was required, while with the diamond die the pull was 35 lb. only.

The polish of the die is another factor of prime importance, especially



AT LEFT

FIG. 3—Relation of pull to drawing speed at low speeds.

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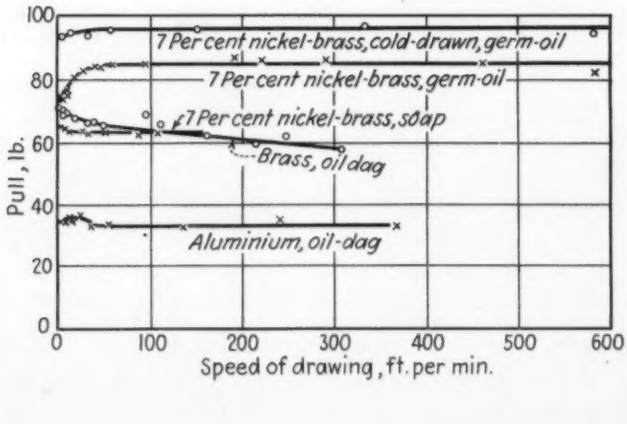
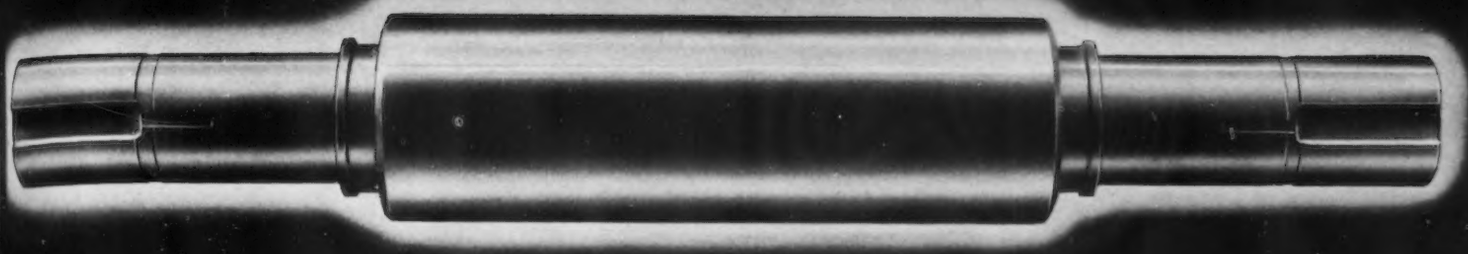
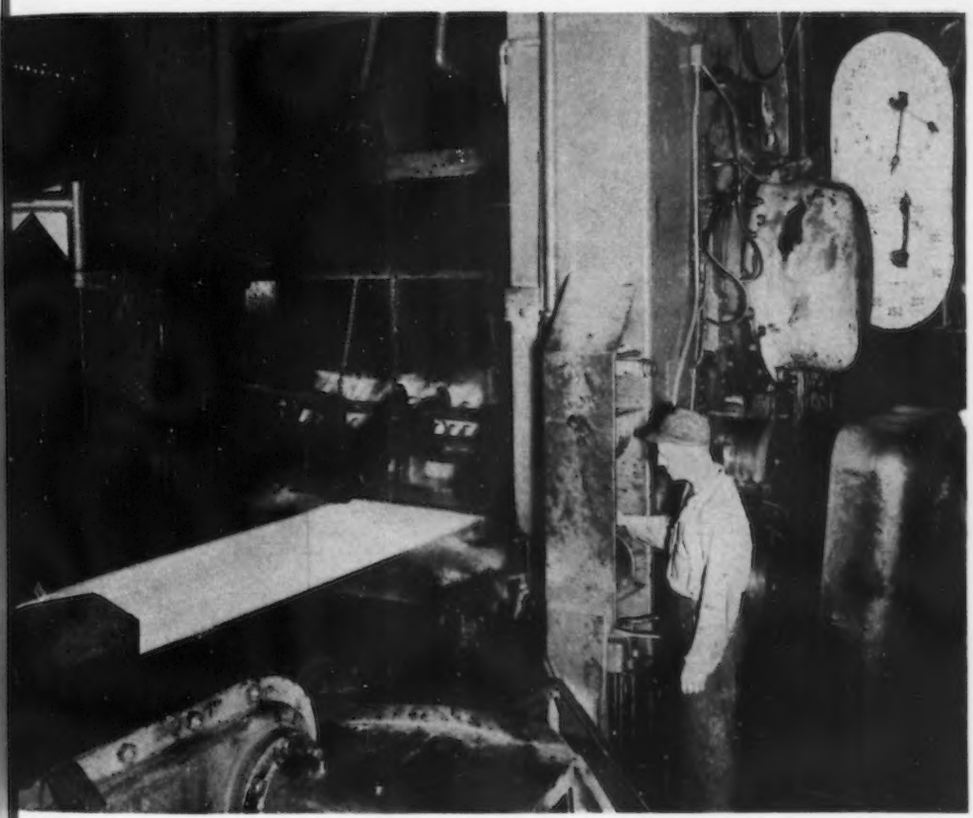
BELOW

FIG. 2—Relation of pull to drawing speed at high speeds.





CROMONITE ROLLS CONTINENTAL'S CONTRIBUTION TO THE STEEL INDUSTRY



PIONEERING IN HIGH-SPEED PRODUCTION

Continental engineers are constantly on the job, pioneering new standards of high-speed roll perfection. They were the first to develop Cromonite—the original hard alloy chill roll to serve hot and cold strip mills. Cromonite is only one of their contributions to the progress of the steel industry.

ANOTHER FIRST FOR CONTINENTAL

Until Continental's engineers developed Cromonite Chill Rolls, it was impossible to secure the uniform, satin-smooth, scale-tight finishes universally demanded by industry. Today Cromonite is the recognized leader in hard alloy roll equipment for denser, more compact surfaces. This practical pioneering development by Continental was not only first to provide the means for obtaining finer finishes but also made possible greater tonnage and longer roll life.

3 PLANTS SERVING THE STEEL INDUSTRY

CONTINENTAL—HUBBARD DIV., EAST CHICAGO, IND.

CONTINENTAL—DUQUESNE DIV., CORAOPOLIS, PA.

CONTINENTAL—WHEELING DIV. WHEELING, W. VA.

CONTINENTAL ROLL & STEEL FOUNDRY COMPANY

CHICAGO, ILL. and PITTSBURGH, PA.

Manufacturers of Rolling Mill Equipment, including Steel and Alloy Steel Castings, Iron and Alloy Iron Rolls, Steel and Alloy Steel Rolls

Continental Direct Fired Annealing Furnaces
Continental Universal Industrial Gas Burners
Pittsburgh-Continental Annealing Covers

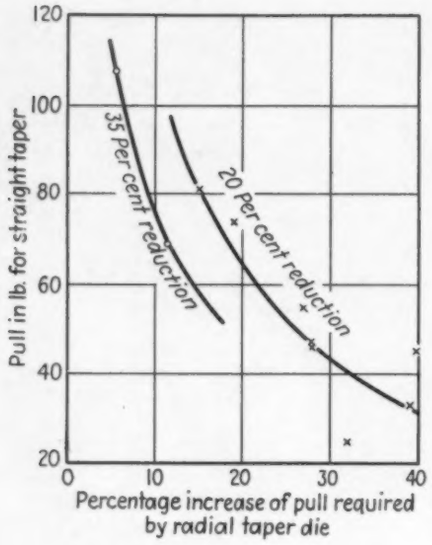


FIG. 5—Evidence that the pull required for a radial taper die is considerably above that needed with a straight taper die of appropriate angle.

where die angles of a low value are employed. (It may be worth pointing out that the die-angle used throughout this article is the semi-angle, i. e., that made by the projection of the bearing surface with the axis of the die.) In Fig. 4 are shown two curves for nickel wire drawn down 20 per cent through dies with a good, and a moderately polished surface respectively, using otherwise exactly the same conditions. These data represent practical evidence that care spent in the preparation of dies of this material is well repaid.

Although in England the vast majority of steel wire is drawn through dies with a plain conical bearing, the so-called "straight-taper," much non-ferrous wire is drawn through "radial-tapered" dies. In Fig. 5 some comparative figures are recorded from which it will be seen that for all the materials examined, the pull required through a radial-taper die is considerably above that needed with a straight-taper die of appropriate angle. It is clear that as the original hardness of the material is decreased and as the reduction effected in the pass is reduced, the radial-tapered die requires a greater and greater excess of tension. The author has never as yet met any case in which the radial taper did not entail increased expenditure of energy, and there is a gradual tendency to abandon the use of dies of this contour even for those materials for which they have in the past been exclusively employed.

The general effect of variations of the angle of the die in the case of non-ferrous metals will be seen from Fig. 6, which refers to reductions of 35 per cent. As this angle is increased the pull required drops to a minimum at about 5½ deg., after which it again rises slightly. This minimum is independent of the material and of the reduction, although for smaller reductions it is less clearly marked. It is independent also of the perfection of the polish of the die and of the speed of drawing. The corresponding curves for a series of steel wires drawn down 20 per cent are shown in Fig. 7. The reason for the periodic fluctuations is as yet unknown, but that they have a real existence is independently confirmed by other industrial measure-

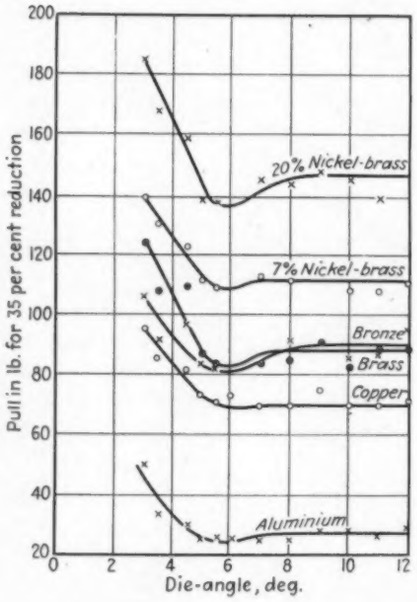


FIG. 6—General effect of variations of the angle of the die in the case of non-ferrous metals.

ments—made moreover with steel dies—which are known to the author. It should perhaps be emphasized that all the work under consideration here was carried out with carbide dies unless a statement to the contrary is made. This work has led to the conclusion that with straight-tapered dies the best angle for most work is 6 deg. Where the reduction of area is small, however, and especially with hard materials, a smaller angle is necessary in order to obtain an adequately long bearing. On the other hand, when starting with rough, hot rolled rod, where the difficulties of efficient lubrication are considerable, a distinctly steeper angle may at times be required, and the results of the author's work would be consistent with the view that where this is the case the angle might well be 10 to 11 deg. Alternatively, there might in such cases be some justification for the use of a radial tapered die, giving the necessary high angle where the metal first enters the die, and decreasing to about 6 deg. at the point of exit. Although the effect of a parallel portion of the die at the exit end has not as yet been investigated, there can be little doubt that this would entail the use of an increased pull, against which must be off-set the increased life of the die before it requires resetting.

Rotating Dies

Rotating dies have been, and still are, to a limited extent, used in the wire-drawing industry with a view to increasing the life of the die by distributing the wear as evenly as possible over the whole surface and, as a result, to improving the surface finish of the wire. When, however, it is solely a matter of increasing the die-life, the employment of rotating dies appears to have been generally abandoned in favor of the much simpler process of rotating the wire during drawing. This can be effected by the use of a special type of swift which is fixed horizontally, the wire being drawn off over the end in laps. This causes the wire to rotate once per lap and the life of the die is found to be definitely prolonged.

In experiments at low speeds of drawing, of the order of a very few

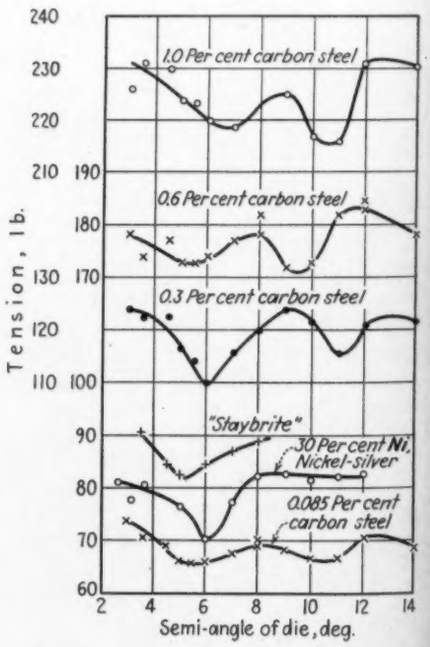
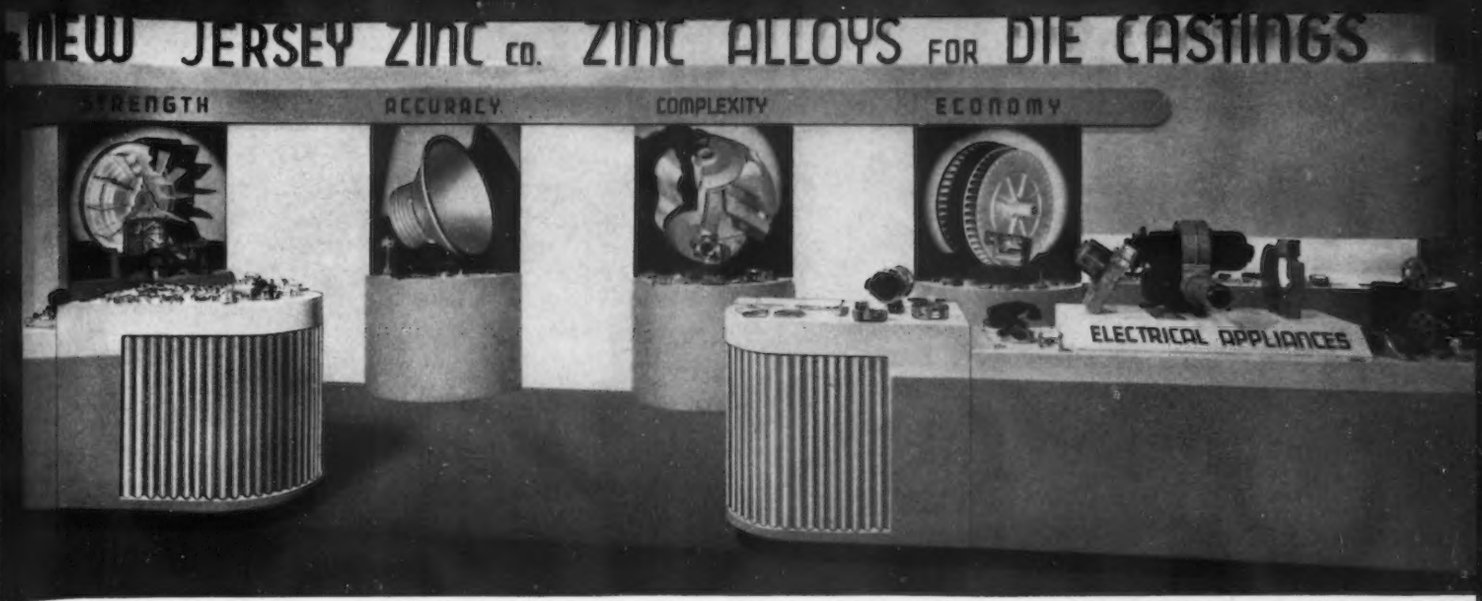


FIG. 7—General effect of variations of the angle of die for steel wires drawn down 20 per cent.



IF YOU CAN'T GET TO THE SHOW

IF you are coming to the National Metal Exposition this year—fine! We will look forward to a visit with you in our booth—B-106. But just in case you are going to be among the stay-at-homes, we have featured, on this page, just four of the hundreds of interesting die casting applications we will have on display.

Each of these four applications illustrates an outstanding quality of ZINC Alloy Die Castings—strength—accuracy—complexity—economy.

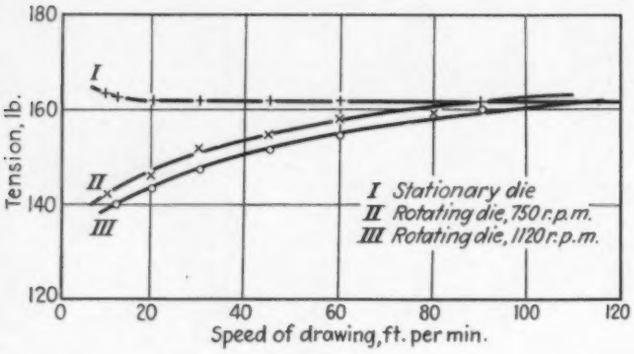
STRENGTH—Every engineer can visualize the strength requirements of an outboard motor flywheel. Exhaustive tests have determined that the die cast wheel shown here will reach 13,000 R. P. M. before bursting. This figure exceeds, by a wide margin, the highest runaway speed in service.

ACCURACY—An efficient flashlight reflector must have a true parabolic reflecting surface, and the accuracy of the die casting process permanently secures this critical requirement.

COMPLEXITY—The complex design of the oil pump rotor was such that die casting was the *only* means of production—without prohibitive cost.

ECONOMY—The economies of the process have been illustrated many times, but we ask that you examine the cage type blower fan shown here—*it was die cast in one piece with ZINC Alloy.*

The surface has only been scratched in the far reaching possibilities of this remarkable metal and method. For additional information consult any commercial die caster—or write to The New Jersey Zinc Company, 160 Front Street, New York City.



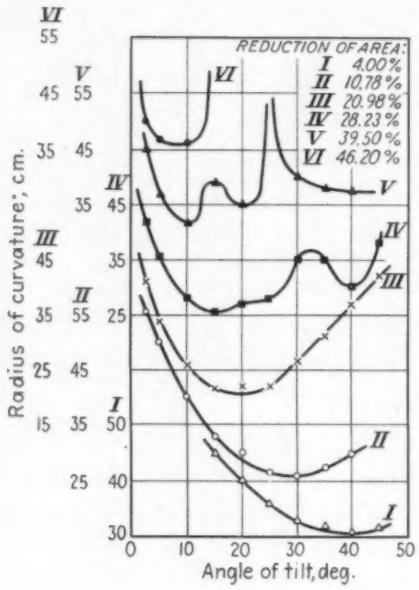
ABOVE

FIG. 8—Note that as the drawing speed rises the advantage of a rotating die disappears.

o o o

BELOW

FIG. 10—Radius of curvature of wire drawn through a tilted die.



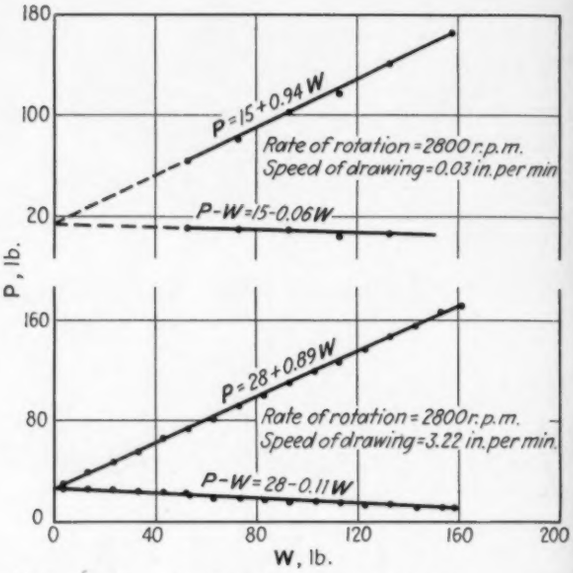


FIG. 9—Effect of a backward pull for mild steel and a rotating die.

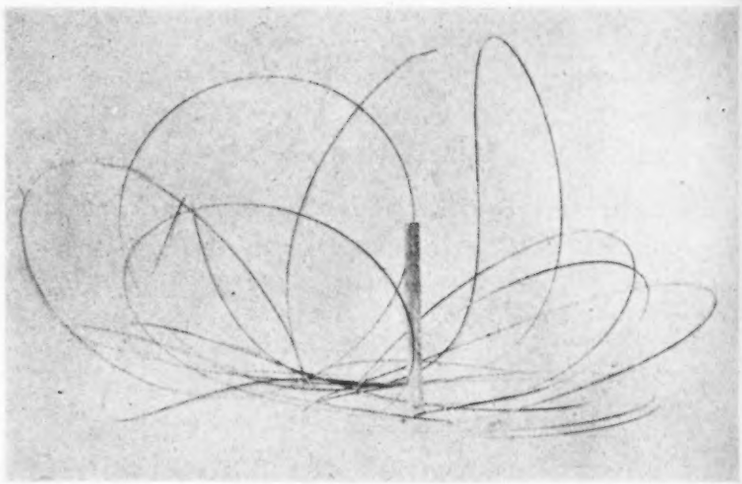


FIG. 11—The "cast" in a "Post Office" bronze wire, with a reduction in area of 21 per cent.

inches per minute, it was found that rotation of the die resulted in a most remarkable reduction of the pull required. In one particular case the load required to reduce a 7 per cent nickel-silver wire fell from 73 lb. with a stationary die to only 29 lb. with a die rotated 160 times per min. As the drawing speed rises, however, the advantage due to the rotation falls, and a point is reached, depending on the speed of rotation, at which the tension becomes greater for the rotating than for the stationary die. This effect is shown in Fig. 8. The effect of varying the speed of rotation is to raise the drawing speed at which this takes place, but especially when the work done in rotating the die is taken into consideration it is clear that no saving of power can be hoped for except possibly in the case of heavy sections drawn down slowly on a draw-bench. It is worth making the point that this is another example of the fact that the conclusions drawn from researches conducted at very slow speeds of drawing lead to results which no longer hold under industrial conditions.

A limited number of experiments on the relative mechanical properties of the wire drawn through stationary and rotating dies have failed to show any appreciable difference between them.

Effect of a Backward Pull

The only experiments which the author has made on the effect of a backward pull have of necessity been carried out on the slow-speed machine and the remarks just made must, therefore, be borne in mind. It has been shown that the imposition of a backward tension W, simultaneously with the drawing load, P, results in an increase in the pull required, but that this increase is less than the reversed tension applied. This applies both to stationary and to rotating dies. The resultant force, P-W, acting on the die, falls as the backward effect is increased and when W is almost as great as P the pressure on the die is so small that it is quite easy to push the die along the wire by hand and thus to effect a 20 per cent reduction of area. It was noted that a rotary motion of the die greatly facilitated this operation. The author is informed that practical application is

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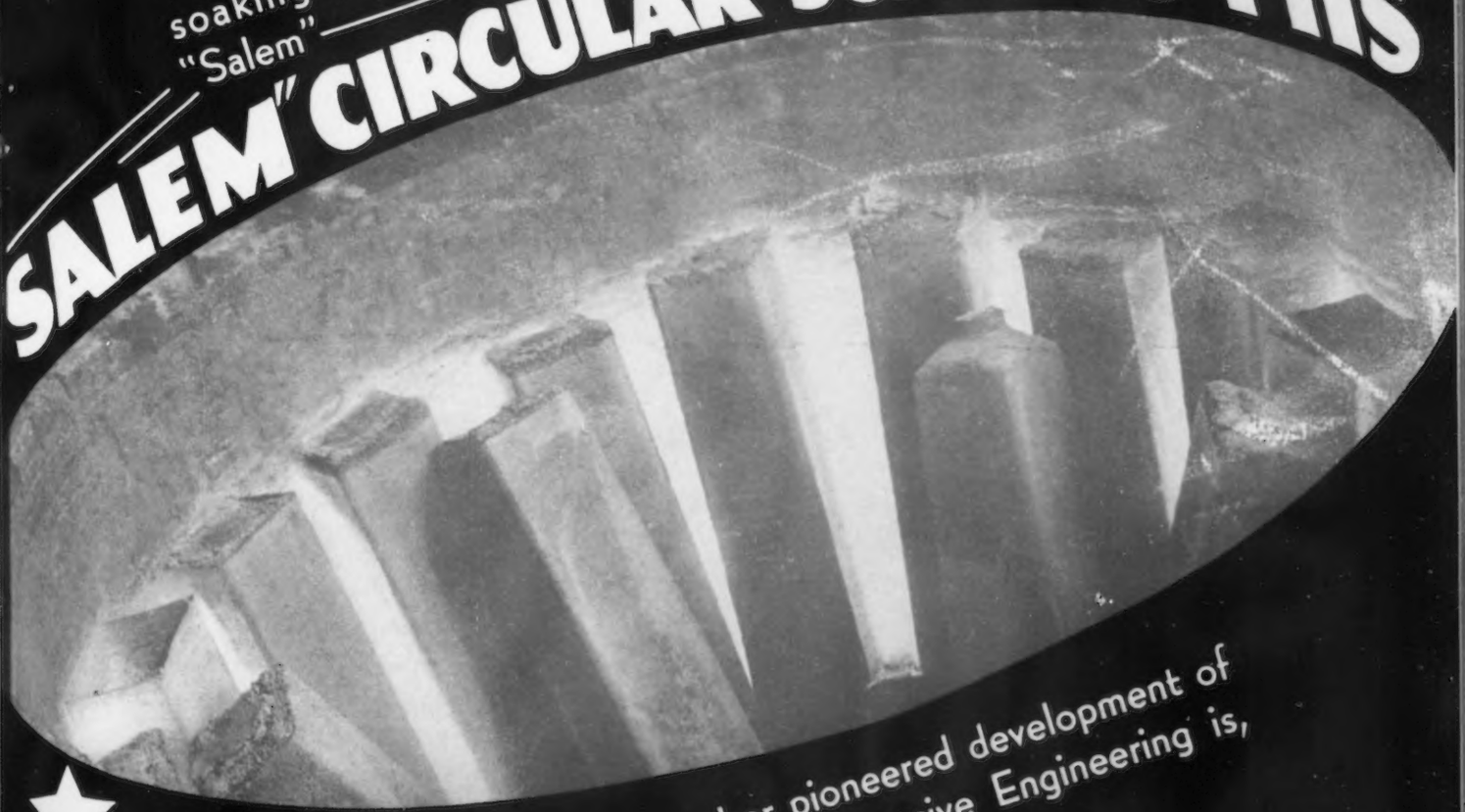

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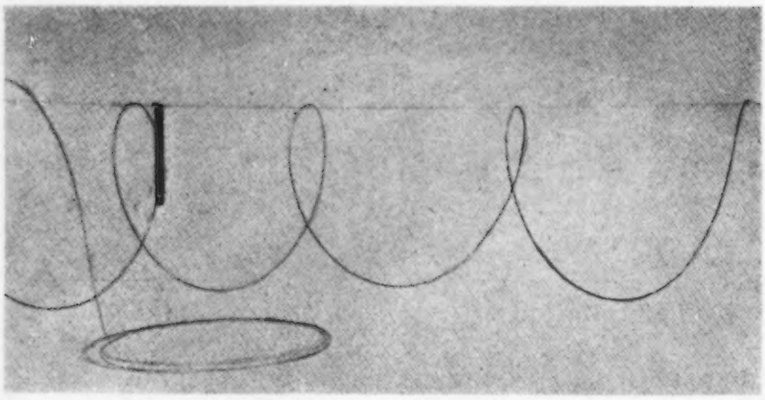

FIG. 12—This is the same coil as in Fig. 11 after disentanglement; two distinct helices with axes at right angles are evidenced.

being taken of the results here recorded to reduce the wear of the die and, therefore, to increase its life. In Fig. 9 are shown some typical results for mild steel and a rotating die. There are reasons for the belief that the nature of the deformation of the metal in drawing with a pronounced backward pull is not identical with that under ordinary conditions. As a result, the mechanical properties of the finished wire may not be the same and under certain circumstances, as for instance when the reduction per pass is very high, the ductility of the wire may be less when a backward pull is applied as compared with that of the same material drawn in the normal manner.

The "Casting" of Wire

The practical importance of the proper "casting" of wire needs no emphasis. Some preliminary experiments have given results which are extremely complex, and for which no explanation is at present forthcoming. In Fig. 10 are shown, for instance, some curves for the radius of curvature of wire drawn through a tilted die and although it is clear that there is a consistent and progressive variation with the reduction of area, the meaning of the results has so far defied elucidation.

One experiment is worthy of further consideration. In Fig. 11 is shown a badly cast coil of "Post Office" bronze wire which was reduced 21 per cent. With very great care this coil was disentangled and the result shown in Fig. 12. It will be observed that the whole of the trouble appears to be located in the first few turns. After disentanglement the coil is seen to consist of two distinct helices whose axes are at right angles to each other. The first helix, which was found to consist of the first few turns of the

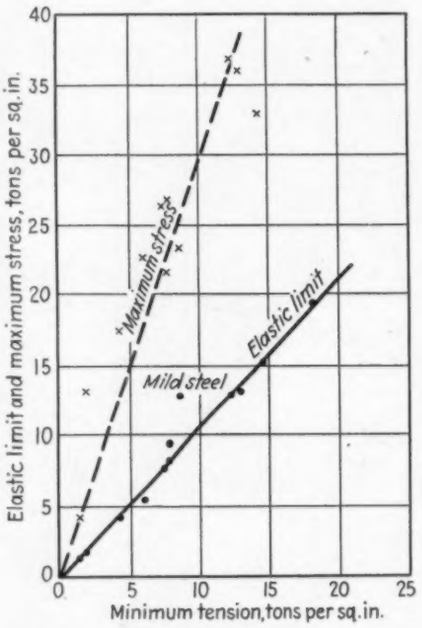

FIG. 13—Experiment shows that the tension necessary to draw wire is a linear function of the elastic limit of the original rod.

coil was cut off, when the remainder cast perfectly satisfactorily. The part referred to was found to correspond to that part of the wire which spirals down from the top of the block to the bottom at the commencement of the drawing, and consequently the conditions corresponded to those obtaining when the die is tilted in a vertical plane. This wire drawn at the beginning of the run was, therefore, given curvature in two planes at right angles. If it is found that these results apply in other cases, the trouble might be overcome by a modified design of block—a possible remedy being the incorporation of the jaws for gripping the wire at the bottom, instead of, as is at present usual, the top.

In the introduction it was pointed out that theoretically the tension necessary to draw wire was a linear function of the elastic limit of the original rod. That this is confirmed experimentally is shown by the results in Fig. 13. Under standard conditions of test it is clear that the pull is a strictly proportional function of the elastic limit of the material before drawing.

Influence of Mechanical Properties

The true elastic limit of wires is not, however, easy to determine, whence it is of value to consider the extent to which the maximum stress can be employed instead. The curve shows, as would be expected, a less close agreement of the individual determinations than does that for the elastic limit. At the same time it shows that for industrial requirements there is a sufficiently good concordance for the maximum stress to be used as a measure of the power requirements. It should be pointed out that this curve is not a constant for all materials and that separate lines should be used for those materials which crystallize in a body-centered, and those in a face-centered cubic lattice.

Reduction of Area

For a very wide range of materials examined, it has been shown that the tension needed to bring about a given reduction of area is a strictly linear function of the reduction at any rate up to a certain value. Above this limit, presumably on account of the large amount of heat generated, the power requirements are rather less than the theoretical treatment would

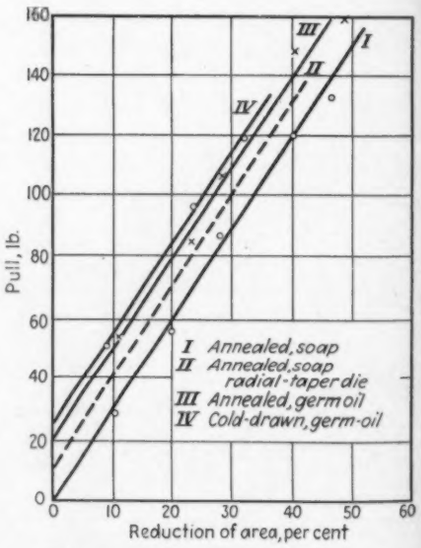

FIG. 14—Tension needed for a given reduction of area is a strictly linear function of the reduction at any rate up to a certain value.

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suggest. In Fig. 14 are shown some results for a 7 per cent nickel-silver, which are typical. (It may be emphasized that for the most part the fundamentals of the wire drawing process are the same for all materials and that there are very few instances in which the general conclusions of our work do not apply to the ferrous as well as to the non-ferrous metals and alloys.) This proportionality of tension and reduction of area has been shown to hold for good and for bad lubricants; for straight-taper and radial-taper dies; for material in the annealed and for that in the already cold drawn conditions.

Single Holing Economical

It will be noted that the curves do not pass through the origin, but cut the ordinate axis at a definite value of the load. Since it can be shown that the intercept on the ordinate increases as the lubricant becomes progressively worse, it is not unreasonable to assume that this intercept affords a measure of the power lost due to friction. If this be so, it is curious and perhaps hardly what would have been expected, that the various curves are all strictly parallel for a given material, suggesting that the frictional loss is independent of the reduction effected per pass.

In certain mathematical work it has been concluded that the power needed should be proportional, not to the reduction of area, but to the logarithm of the ratio of the original to the final areas of cross-section. As will be seen from the dotted curves of Fig. 15 the experimental results are not consistent with the view that the pull is directly proportional to this function. This fact affords one of the reasons for doubting the fundamental assumptions on which such mathematical work has been carried out.

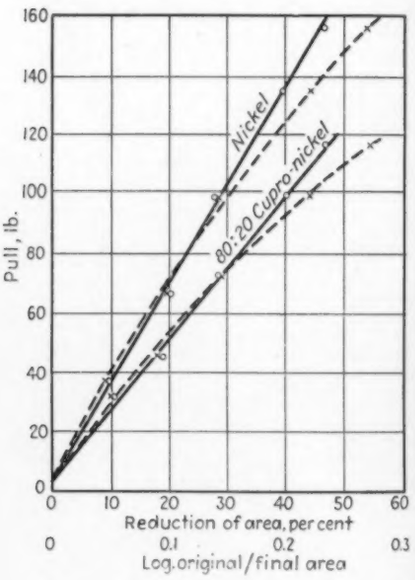

FIG. 15—Experimental results do not confirm that the pull is directly proportional to the logarithm of the ratio of the original to the final areas of cross-section.

In a very short attempt to compare the power consumption in effecting a given reduction of area in one or in two passes, it has been shown, as might perhaps have been expected, that single holing is the more economical procedure from this point of view. For a total reduction of just over 40 per cent it was shown that about 9 per cent more power was consumed in bringing about this reduction in two more or less equal passes as compared with that for a single pass.

(CONCLUDED ON PAGE 156)

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FREEZING OF RIMMED STEEL

By HENRY D. HIBBARD
Consulting Metallurgist, Plainfield, N. J.

WHAT happens during the teeming and freezing of a rimmed steel ingot made by the basic excess-of-crude-iron open hearth method? The author attempts to answer this important and somewhat mysterious question by describing the sequence of gas liberation in the mold, and the results of such liberation on the character of the steel ingot.

IN considering the action during freezing of a rimming ingot, it is first necessary to assume that the steel itself is of the best average type, treated properly in the furnace as to successive temperatures, successive boils, ore additions, slag treatment, and other requirements. The steel is bottom-cast as one of a group of eight ingots weighing in all about 16 tons, each mold being 12 x 30 in. in cross-section, the ingot being about 4-ft. tall. The ingot has the usual three kinds of gas holes called sometimes, from their locations in the ingot, *skinholes, intermediate holes, and central holes.*

Skinholes have been found to be filled chiefly with hydrogen gas and so will hereinafter be called hydrogen holes. They are present in most rimmed steel ingots. Each hydrogen hole is of the well-known elongated shape with its longer axis perpendicular to the ingot surface. When present, these holes are located in zones nearly parallel to the surfaces of the ingot, extending up from the bottom. There may also be some in a zone extending over and parallel to the bottom plate. On the sides of the ingot, between the hydrogen holes and the surface, is the primary skin of solid metal, the thickness of which largely determines the structural excellence of the ingot. The thicker it is the better.

Intermediate holes have been found to be filled chiefly by carbon monoxide, CO, and so will be designated by that name. They are usually roughly spherical in shape and located irregularly in narrow zones extending the whole height of the ingot all around and 2 or 3 in. from the surface. These zones are usually slightly nearer the outer surface at the top of the ingot than at the bottom, located evidently along the shell which has been solidified by the time the central metal has become mushy. This shell is thickest around the bottom of the ingot, as it has been forming there throughout teeming.

Gas Action Examined

So far as is known by the writer, the gas in the central holes has not been analyzed. Therefore they need no other name. They are thought to be filled chiefly by nitrogen or ammonia for the following reasons: (1) In location and general character they are quite different from the other holes mentioned. So the gas in them is manifestly different from the gases in the other holes. Next to hydrogen and carbon monoxide, nitrogen and ammonia are the most abundant of the gases which have been found in steel; so it is probable that they, or one of them, form these central holes. (2) Ingots of killed and partly killed steel sometimes do yield ammonia from their central parts; and (3) contact with nitrogen of the air in the blast furnace and steel furnace has been ample to insure that the molten metal is saturated with that gas.

The ingot being considered herein has a primary skin of clean solid steel

AS the rimming steel ingot cools from the outside in toward the center, a fusible scum gathers on top of the churning metal. The Carnegie-Illinois workman is shown here removing as much of the scum as possible.

o o o

½ in. thick, inside which is the zone of hydrogen holes extending over the bottom and up the sides about one-fourth the height of the ingot.

Inside the hydrogen holes is the secondary skin of solid steel between them and the carbon monoxide holes. Above the hydrogen holes the two skins form a single layer of solid steel between the surface and the carbon monoxide holes, which layer averages about 2 in. thick all around the ingot. In the central parts are a few scattered central holes.

The ingot has a flat top and the central metal has neither risen or settled, though it would have risen somewhat if not prevented by its cap. The ingot's average composition is C = 0.10, Mn = 0.35 P = 0.02 and S = 0.04 per cent.

First, it is advisable to follow the course of the gases — hydrogen and carbon monoxide—first in the bath metal and then during cooling and freezing in the mold. Next, segregation in the ingot and the ingot scum should be considered.

The sources of hydrogen in the fluid steel are, or include:

(1) That in the crude iron of the charge.

(2) Water vapor or steam in the air employed in making producer gas.

(3) Water vapor in the air employed for combustion.

(4) Water vapor formed by combustion of hydrogen in the fuel.

Water vapor in contact with melting iron is decomposed, its oxygen uniting with the iron to form oxides, while its hydrogen is absorbed by the metal.

The amount of moisture in the atmosphere varies greatly as the weather changes. So the amount of hydrogen in the metal varies accordingly, which calls for corresponding changes in practice.

The only agency in sight for driving hydrogen out of the bath metal is the boil, so-called. It seems not to be oxidized, or to be able to leave the bath metal unaided. So the escaping carbon monoxide bubbles may and probably do carry off hydrogen with them. Consequently, other things being equal, the more boil the less hydrogen will be in the metal in the ladle. The boil should also be vigorous as well as adequate in volume. With ample carbon in the metal, or say over 0.20 per cent, the boil should be brisk, that is the escaping bubbles should almost crowd each other.

As boil means loss of carbon it follows that, in a given charge, the more completely the carbon has been eliminated the more boil has taken place. Hence the more complete elimination of hydrogen. The extreme illustration of this is ingot iron, which is almost free from carbon, an ingot of which may contain no hydrogen holes whatever.

All this indicates that in damp weather, when humidity in the air is high, the boil should be continued longer than in dry weather. This requires constant examination of the atmosphere for moisture. Additional carbon in crude iron or spiegel may be added at the end to give the desired strength to the steel.

Manganese tends to check the vigor of the boil and probably has some solvent power for hydrogen. For those reasons it should not be too high in the charge and bath metal, perhaps not over 0.05 per cent at the end before the final additions.

Action During Teeming

After the final furnace additions, if any, the heat is tapped and flows into the ladle where any needed further additions are made. The ladle is then taken to the casting platform and teeming begins about 15 min. after tapping, which is usually proper.

Cooling and freezing of the metal as it loses heat are gradual and continuous throughout, from the beginning of teeming until the ingot is solid, and usually further until it is cold. Loss of heat before total solidity controls largely the phenomenon of ingot making of rimming steel.

The first metal which enters the mold spreads over the bottom plate within the mold and at once begins to

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evolve gas in bubbles with effervescing effect, which action continues throughout teeming and solidification. The gas is mostly carbon monoxide and its escape from the metal in the mold is the peculiar characteristic and most important phenomenon of rimming steel. For good results it must be right. Each bubble starts below, and, as it rises, grows larger from accretions of gas which it gathers, while diminishing ferrostatic pressure allows it to expand and so to enlarge still more.

Each bubble of gas as it escapes leaves—momentarily of course—a hole in the molten metal which at once rushes in from the sides to fill the vacated space. The collision of such inrushing metal at the numerous holes throws up into the air a small shower of droplets of molten steel to a height of a foot or two, making a pretty pyrotechnic display.

The escaping gas bubbles give the molten metal an active motion like churning which has important effects. Churning consists essentially of upward currents of metal around the outside, next to the ingot shell, and downward currents in the center. The outer metal touching the frozen wall is cooled and thereby made to disgorge most of its carbon monoxide before and during freezing, which, rising, induces churning. This action continues until the mold is filled as desired, and further, until the ingot is capped.

A most important effect of effervescence in the mold is, apparently, to carry off from the metal hydrogen which has survived the boil in the furnace. That gas seems to be carried off by the other escaping gases from the metal in the mold with increasing aptitude as the metal, losing heat, and approaching its freezing point, also loses most of its solvent power for gases. So in the ingot, the expulsion of hydrogen during churning has been nearly complete. Still some remains in the unfrozen metal.

During the teeming of the ingot being considered herein, freezing of the steel touching the bottom plate and mold around the lower part has begun, thus starting formation of the ingot shell, which continues to grow, both in thickness and height, throughout teeming. Quickly after teeming is finished the solidified shell appears at the top next to the mold and around the churning central metal as a rim; hence the name.

The visible rim, being cooled from the top by radiation as well as by contact with the mold, increases in width faster than the shell just below it increases in thickness—perhaps twice as fast or nearly so.

Delay in the appearance of the rim, caused perhaps by rising steel flowing over it, would indicate that hydrogen holes were forming around the bottom of the ingot near the surface—a harmful feature.

The solidified shell, as it grows, rejects some of its impurities, both liquid and gaseous, including hydrogen, which are either expelled at once by rising to the top or are taken in by the still fluid central metal. That metal, in turn, becomes saturated with hydrogen in spite of its evacuation by the effervescence. The metal then already frozen constitutes the primary skin of the ingot. In the ingot considered here, it is ½-in. thick.

As the concentration of hydrogen in the liquid central metal passes its

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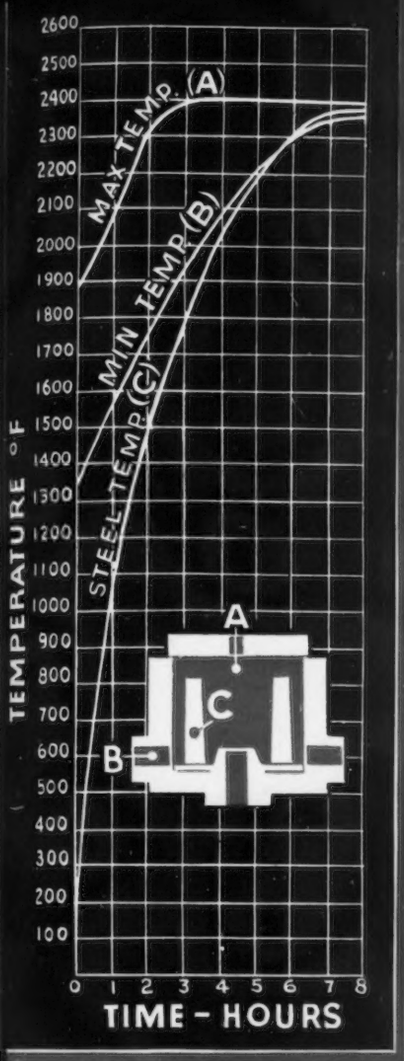

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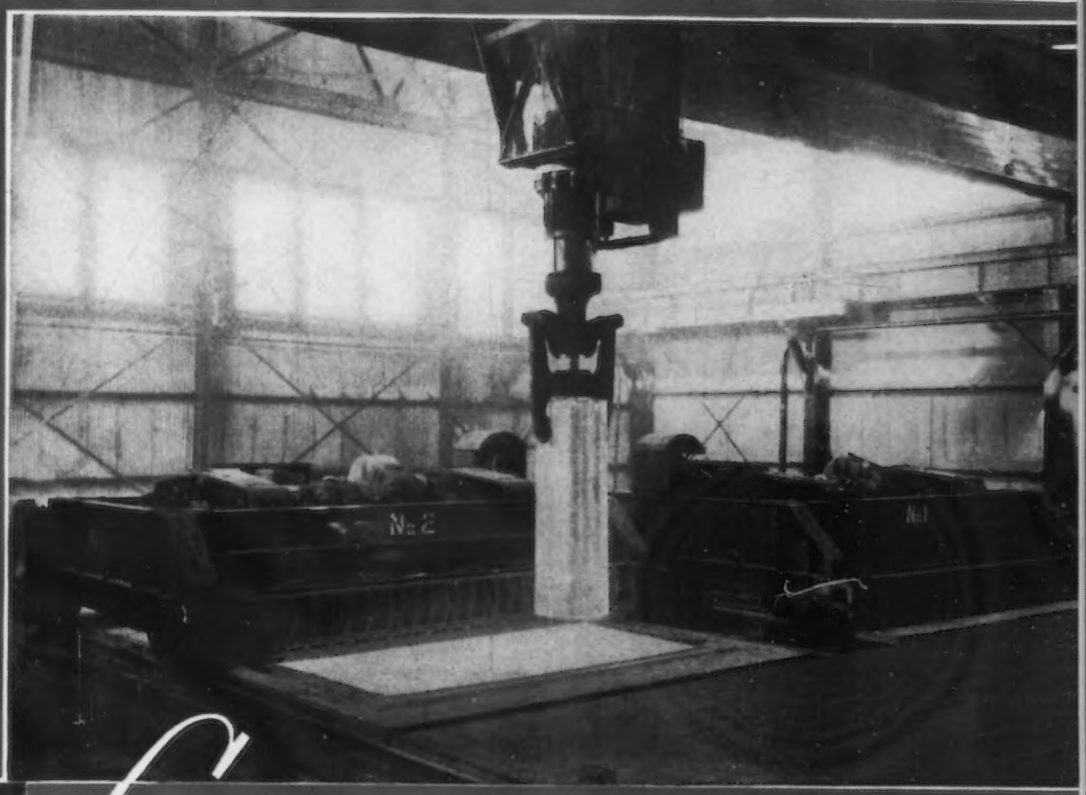

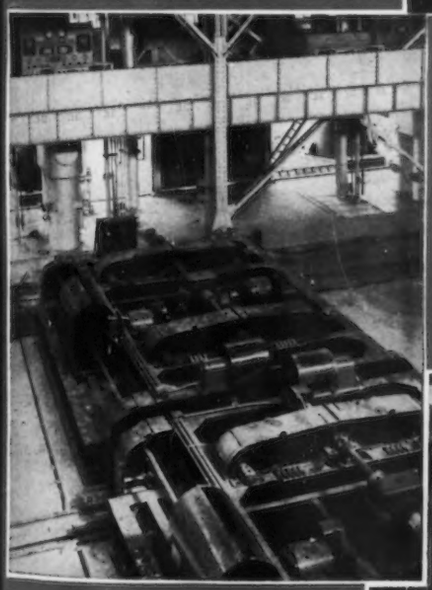

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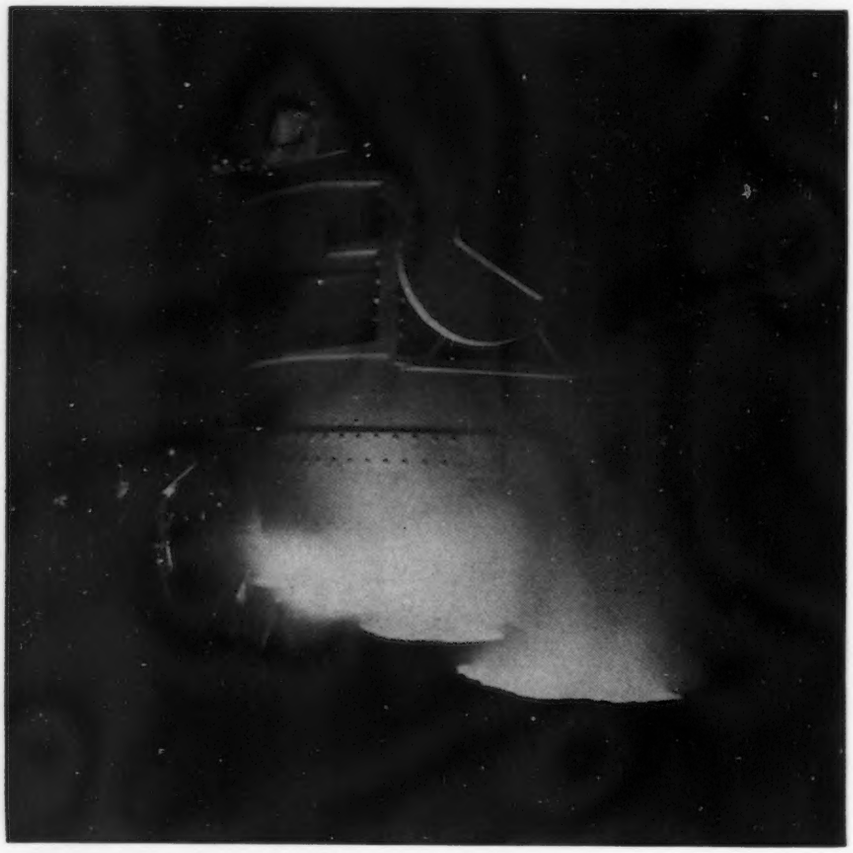
saturation point it begins to separate in bubbles of its own which tend to attach themselves to the inner side of the shell of solidified steel. If there were no further churning of the metal they would all stay there. Some do so.

Churning Dislodges Hydrogen

As already stated, the bubbles of effervescence become larger as they rise from the bottom upward in the mold. So the churning they cause varies with them in vigor at the different depths—weakest at the bottom and strongest at the top. This churning dislodges the hydrogen bubbles clinging to the solidified shell wherever it has enough violence. In the ingot here considered that is everywhere except over the bottom and up the sides one-fourth of the ingot height, while even in these excepted locations a part of them may be dislodged. Over the bottom where the metal is quiet, with little or no churning action some bubbles may stick and form characteristic holes which are missing elsewhere in the ingot. Each hydrogen bubble which remains attached to the ingot shell grows by accretions of gas, which it receives from the still fluid metal, on the side which touches that metal; that is, toward the interior of the ingot; hence its elongated form. The dislodged bubbles rise to the top and escape.



TEEMING rimming steel ingots. The first metal enters the mold and spreads over the bottom plate within the mold and at once begins to evolve gas in bubbles with effervescing effect, which action continues throughout teeming and solidification. Photo courtesy Carnegie-Illinois Steel Corp.

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As cooling proceeds the central metal becomes mushy in consistency so that its evolved gases cannot escape freely. The last of the carbon monoxide to leave the metal then forms the intermediate holes, located as described. After that the central holes are formed which, as they cannot escape, tend, together with the last carbon monoxide to separate, to push upward the metal above them and so to make it rise. That is prevented by a cold thick cast iron cover or cap laid on the rim after it has become an inch or more wide.

When there is no effervescence in the mold, as may occur because of a much too high casting temperature, or it is too feeble, as from too rapid teeming, the saturation point of hydrogen in the metal may be passed almost or quite at once—in extreme cases before teeming is completed. As the saturation point is passed in such cases, skinholes begin to form close to the ingot surface, and the ingot is bad. If the primary skin is thin, as it will be in such a case, and the ingot is stripped red-hot, the height to which skinholes extend may readily be seen, as the metal about them, lacking solidity, cools faster than that above them, and may look black while the upper part of the ingot is still red. The upper part of such an ingot is more solid and so better than the lower. When there is no effervescence the collective volume of hydrogen holes formed may amount to 20 per cent of the bulk of the ingot.

Too rapid teeming, which may cause a thin-skinned ingot, may come from too few ingots in a bottom-cast group, or from top-casting one ingot at a time. Therefore for top-casting the boil in the furnace should be stronger and continued longer and a smaller nozzle in the ladle should be used than when the steel is to be bottom-cast in a large group.

An essential condition in casting to secure proper effervescence in the mold is therefore that it must be cooled there at a proper rate. If that rate is too slow the evolution of gas is too sluggish, and hydrogen holes form too near the surface because saturation comes sooner.

Segregation and Scum

The composition of the ingot herein considered varies in its different parts. A thin shell of metal in contact with the mold and bottom plate freezes so quickly that it has the average composition of the whole. In the other parts the composition is altered by segregation which is a notable feature or defect of rimmed steel, as indeed it is of all but killed steels. This segregation is the partial collection of the soluble impurities, specifically carbon, phosphorus, sulphur and oxygen, each combined with iron, in the upper part of the ingot. It is due chiefly to the motion of the molten metal.

The steel as it slowly freezes leaves out or rejects some of its impurities

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which are then washed away and upward by the churning metal. The impurities mentioned are so dealt with. The central metal as a whole thus becomes more impure than the average of the ingot and this gain in impurities gradually increases until the whole ingot is solid, so that the last to freeze, which is naturally the upper central part, is the most impure of all.

Scum Gathers on Top

The impurities mentioned, that is, carbide, phosphide, sulphide and oxide of iron, being lighter than iron, tend slightly to rise by gravitation through the liquid metal and also to remain in the upper part of the ingot after they have risen or have been carried there by the churning. The interior metal in the lower part of the ingot is thus likely to be slightly purer than the average. This feature is negative segregation or impoverishment of impurities.

Thus through the migration of soluble impurities due to gravitation and churning, the composition of the ingot is not uniform throughout.

The writer is skeptical as to the true segregation of manganese or silicon. These elements, if unoxidized, are or may be alloyed with iron and not combined and so may be immune to the segregating forces or influences. So if the chemist finds in the segregated regions of rimmed steel more than the ingot average of those elements, the excesses are presumably there as non-metallic, infusible silicate of manganese and iron, particles of which may be entrapped in the mushy metal while on their way to join the scum, noted later. Killed steel segregates but little which indicates that that feature of rimmed steel is due chiefly to churning as described.

As the ingot cools in the mold a fusible scum gathers on top of the churning metal, which grows in volume until freezing is completed, and remains liquid after the metal is all solid. This scum is chiefly silicate of manganese and iron, and trials have shown that the larger part, perhaps three-fourths of it, was in the steel in the ladle, having been formed either in the bath metal during working, or by the reactions of silicon and manganese in the final additions with oxide of iron in the metal. In either case it is in extremely small particles in the metal. Motion of the liquid steel makes most of these particles touch each other and so to coalesce, forming successively larger and larger masses which churning brings to the top where they form the scum.

A small part of the scum is evidently formed by oxidation of the droplets thrown up by effervescence into the air from the metal as already noted. This purification of the metal of its non-metallic impurities by their transfer to the scum is manifestly an important agency for improving the quality of rimmed steel.

Some of these particles of silicates may not reach the top, but may be held in the upper parts of the ingot where segregation is most pronounced. So the silicon and manganese may appear in the report as segregation.

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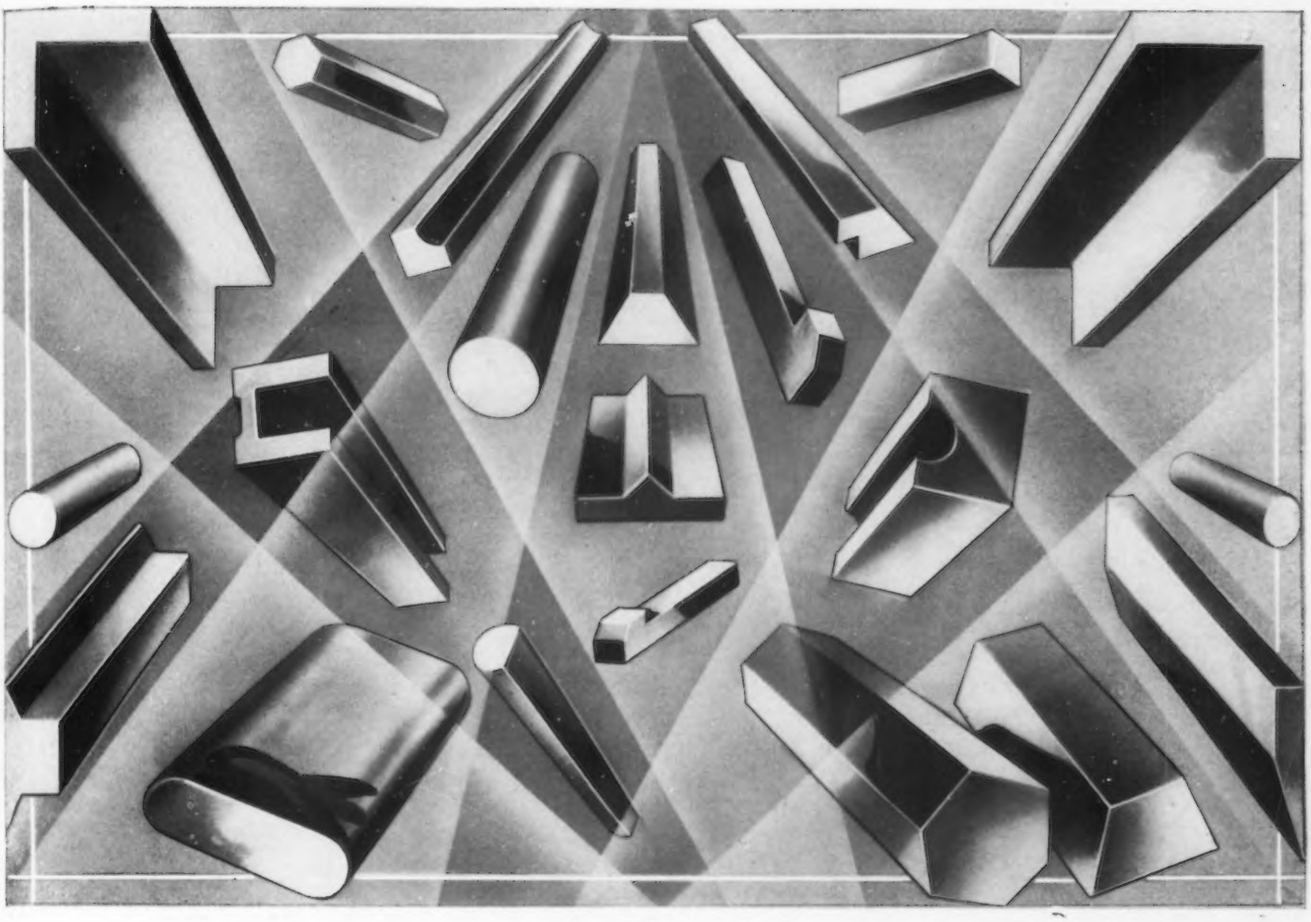

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Copper-Chromium Alloys

o o o

By M. G. CORSON
Consulting Metallurgist, New York

o o o

COPPER-CHROMIUM alloys occupy a most distinct position among the alloys of copper. Quite unknown until 20 years ago and only subject to scientific studies beginning in 1924, they came into industrial use about 1930. Now, they show evidence of becoming at least as important as any of the alloys previously known.

The discovery of rustless iron-chromium alloys on the eve of the Great War aroused hopes that chromium might exert analogous influences upon copper. These hopes were the more justifiable, because nickel—a close ally of copper in its alloy forming proclivities—was known to form the ni-chromes with their high and uniform resistivities to an electric current and excellent resistance to numerous corrosive media.

Large scale tests were made first by the Electro Metallurgical Corp. at Niagara Falls. There molten chromium was introduced into molten super-heated copper, and the resulting alloys carried as high as 10 per cent chromium. This was an intermediate alloy for further use but indicated that the chromium did not form a solid solution in copper as it does in iron and nickel. It crystallized in rosettes of irregular oval grains forming quite a beautiful pattern under the microscope. The alloy, however, had neither a high resistance to corrosion, nor even the capacity to be forged or rolled.

Were it not that one industrial concern began to use chromium as an additional element in a variety of duralumin, the manufacture of copper-chromium would have ceased then and there. As it was, the granulated 10 per cent chromium-copper alloy found a small application and now and then a few tons of the master alloy were actually sold at a small profit. Such is why the master alloy in the shape of granules has been fairly available for experimental work.

Later some experimental work was done on copper-chromium alloys in the laboratories of the Renssellaer Polytechnical Institute. Wires were made with up to 5 per cent chromium and their electric as well as tensile characteristics studied. The essential conclusion that might have been made from those experimental data would be that such alloys differ extremely in their characteristics, as hard drawn (from a small ingot) and as later annealed. Such differences were unknown for other alloys of copper. But such a conclusion was not developed, and no further work was done on copper-chromium alloys until 1924. Studies made at that time showed the following:—

That primary round grainlets of chromium begin to appear when as little as one per cent chromium is added.

That the melting temperature of such 1 per cent Cr alloys is but little lower than that of copper itself.

That at the melting temperature copper will take about 0.65 per cent chromium in solid solution, while at 1706 deg. F. as much as 0.55 per cent dissolves completely.

That nearly all chromium will precipitate on slow cooling, leaving an alloy of high conductivity but of low strength and hardness.

That an artificial precipitation from a quenched supersaturated solution, induced by heating to 842 to 1022 deg. F. results in particles of high conductivity possessing a vastly increased hardness and strength.

That a preliminary deoxidation of copper was most important because it helps to save chromium and to produce clean ingots with no chromium oxide entangled between the grains.

That a simultaneous presence of silicon is most beneficial, because it permits the precipitation of chromium silicide—a process much easier to control than the precipitation of chromium itself.

Those early studies were practically confined to investigations of the characteristics obtainable in rolled and

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drawn products (wire and sheet metal), the facilities for sand casting having been most inadequate. Presenting the results in a condensed form it might be said that wrought copper-chromium alloys with less than 0.5 per cent chromium were found to develop in precipitation hardening a brinell hardness of 105 to 110, a tensile strength of 56,000 lb. per sq. in., (standard test bar), proportionality limit of 25,000 lb. and a yield point of 35,000 lb. The elongation was 35 per cent and the area of reduction around 50 per cent. Electric conductivity would normally return to 82 per cent of standard copper, after dropping to 30 per cent, due to a solubilizing heat treatment at 1652 to 1706 deg. F.

Commercial interest in the use of wrought copper chromium and copper-chromium-silicon alloys was limited and the new alloys did not progress beyond the experimental stage for some time.

Then, suddenly enough, some progressive foundries got the idea of trying these alloys for casting. And it was soon found that the high conductivity of such castings containing about 0.6 per cent chromium corresponded thoroughly to certain classes of industrial requirements. The 100 per cent increase in strength, 200 per cent increase in Brinell hardness and 500 per cent increase in elastic limit in comparison to straight copper helped the new alloy greatly in the conquest of such fields. To-day their uses appear to expand continuously and there is no real reason why they could not supplant a number of tin-bronzes and aluminum-bronzes in various other applications.

Of the latest theoretical discoveries in the field of copper-chromium alloys the following should be mentioned:

Chromium will form with silicon three compounds: Cr_3Si, Cr_2Si and CrSi. When large amounts of copper —as in copper-chromium alloys— are present, a competition of the two metals for the silicon takes place.

If enough chromium is present to combine with all silicon to form Cr_3Si, the combination will be quantitative and practically the whole amount of Cr_3Si, plus whatever excess chromium, if any, can be precipitated to an advantage. A conductivity of 85 per cent can be obtained without fail.

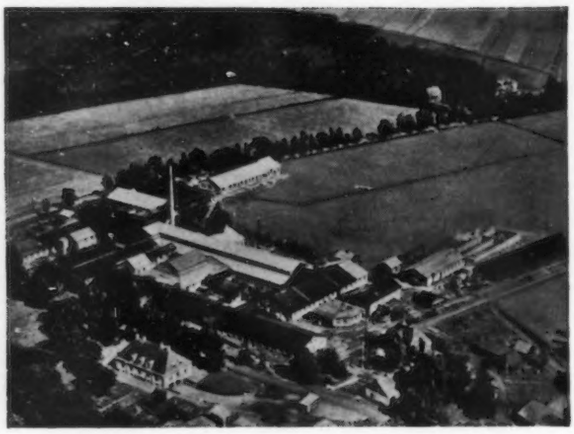
If enough silicon is present to form Cr_2Si the precipitation will not be so complete. The resulting conductivity will amount to 78 per cent.

If enough silicon is present to form CrSi a considerable amount of this compound will form as a eutectic and will not redissolve during the solution treatment. A part of the silicon will be taken over by copper and the conductivity will drop to 70 per cent. On the other hand the small amount of chromium going into solution will not suffice to produce the maximum hardening possible.

The above shows that the ratio of chromium to silicon is by no means critical, although on the other hand there is no reason to add silicon lavishly. If 0.6 per cent chromium is present in the alloy, the silicon content should be between 0.07 and 0.13 per cent. In the first case there will be precipitated an excess of metallic chromium, in the second a small amount of Cr_2Si in addition to Cr_3Si.

Another important fact is that silicon can be advantageously replaced by beryllium which forms the compound CrBe. It necessitates 0.1 per cent Be to take care of 0.6 per cent chromium.

The making of copper-chromium alloys is an easy process, requiring but little experience to produce good re-



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sults. One has to start with the purest copper available, the cropped ends of OFHC ingots and billets forming the best material possible. The metal should be protected from oxidation. When fully molten, it is deoxidized by adding copper-cadmium or copper-calcium-silicon, although the cheapest and satisfactory way is to use about 0.6 per cent of standard brass scrap. Next silicon is added as cupro-silicon and this is immediately followed by the copper-chromium master alloy. The latter should be used in the shape of small ingots, because the old type of granulated alloy carries too much oxide on its surface.

One may also use chromium metal finely ground and introduced through a layer of molten flux, or briquettes of chromium and copper powders. The cheapest way is of course the one where metallic chromium is used. Under certain conditions the recovery of chromium might not be as good as when the master alloy containing about 10 per cent chromium and 90 per cent copper were used. With ingots of the master alloy hardly any loss takes place.

Standard test bars of the heat treated cast alloy show must uniform results. They have a hardness of 100 to 105 Brinell and a tensile strength of 48,000 to 52,000 lb. per sq. in. This means that the difference between the wrought and the sand cast bars amounts to 4000 to 8000 lb. or 7 to 14 per cent only. One has to remember that it is an excellent test bar of admiralty gun metal that shows 45,000 lb. strength while the same alloy when wrought and annealed possesses 60,000 lb. per sq. in. ultimate strength—a difference of fully 25 per cent.

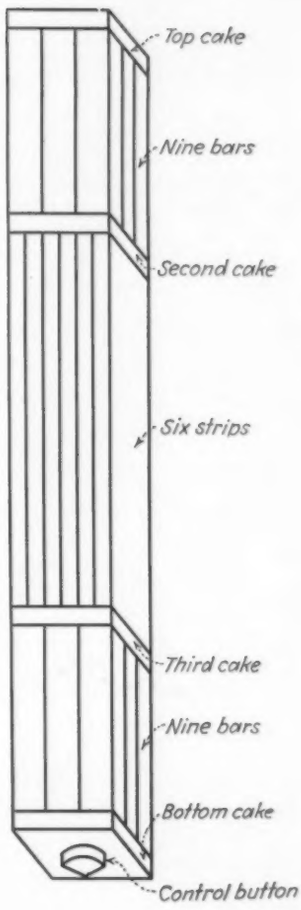

FIG. 1—Method of cutting the bars into various sections for the different physical tests.

The question arises: How are the characteristics of the standard test bars reproduced in the case of much larger and not so much pampered castings? Will the effects of the two heat treatments penetrate just as uniformly through a much larger section? Won't there be an effective segregation of chromium from surface to center and from bottom to top?

To answer these questions the author obtained special castings from three producers of copper-chromium cast articles. They had the shape of square bars 22 in. long and 2.7 in. x 2.7 in. in cross-section at the top, slightly tapered toward the bottom. Each foundry supplied two bars, one as cast, one as heat treated.

These bars were cut up into 29 sections as shown in the sketch of Fig. 1. The two chunks 5 in. long, one taken from the top, the second from the bottom, were divided into nine bars each. Five of these bars were machined into standard test bars, four into impact bars with three notches in each. This gave ten tensile tests and eight impact tests to each casting. Not all of the test bars were tested, a few being spoiled in machining.

(TO BE CONCLUDED NEXT WEEK)

FLAME SCARFING

(CONTINUED FROM PAGE 53)

essentially 1:1, oxygen-acetylene, or about the same as in most preheating operations, although the general practice is to keep slightly on the oxidizing side to secure a faster pick-up.

One other striking difference between this machine and ordinary torch cutting is that the slag produced by the former is fully suitable for recharging into the open hearth or blast furnace for recovery. The flame scarfing machine produces a slag containing approximately 80 per cent steel and 20 per cent oxide, whereas oxy-acetylene cutting slag has proportions almost the reverse.

As to the economy of most mills in using such a machine as this, it seems to be fully justified for any mill handling blooms of over, say, 5 in. by 5 in. cross section. Highly alloyed steels are particularly treatable, there being no danger of air hardening, as the steel is conditioned while hot and there is no reheating involved. The Driox oxygen system simplifies oxygen delivery, and acetylene generators take care of the other gas requirement.

The performance of the machine has been adequately demonstrated, the proof of the entire pudding being that users of machines are planning even more elaborate machines.

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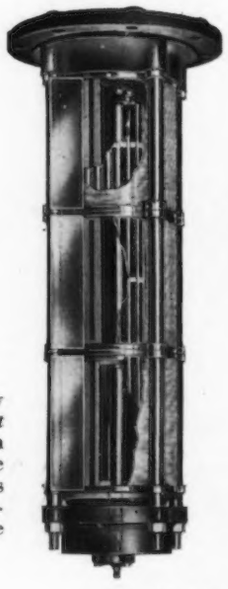

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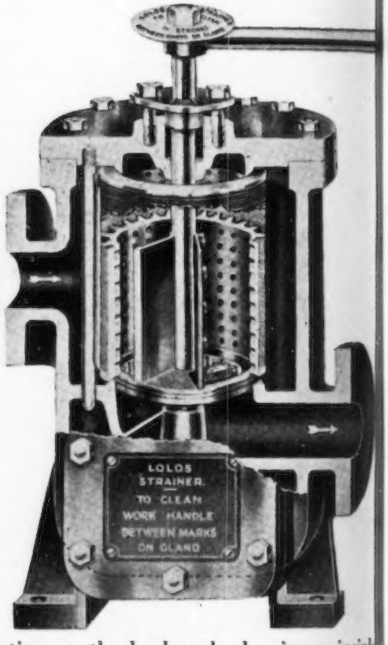

3 Also operating on the backwash cleaning principl and available in the same fine spacings, is the Lolo filter, similar in operation to the Flo-Klean excep that the backwash is supplied by an internal van type pump which may be hand operated, eliminating the necessity of a motor drive. As in the Flo-Klean *the backwash fluid is not wasted.* Like the rest of th Cuno family, the Lolos works over a wide range o temperatures, viscosities, and pressures . . . can b built to suit *your* needs.

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Stress Relieving and Preheating

By W. G. THEISINGER

Welding and Metallurgical Engineer, Lukens Steel Co.

THE use of welded steel has increased rapidly over the past ten years and is probably a better indication of the advancement of the art than any other single factor. Indicative of this growth is the fact that at least 85 per cent of the steel produced by the Lukens Steel Co., rolled plates and flanged heads, goes into some form of welded construction. Furthermore, this proportion of a mill's rolled steel tonnage now being used by welding fabricators is not limited to one company but is, in general, applicable to the whole steel making industry. Considering the total rolled steel output during any one year in terms of this percentage is proof of the volume of work passing through the many fabricating shops and the importance of such shops as consumers of steel.

Naturally, as the volume of business grows, the aggregate value of materials, equipment and labor increases, thus requiring greater attention on the part of all concerned, including management, to the details which are fundamental in securing the best work at reasonable cost. It is fortunate that welding has made possible the combination of practice and research to a degree not always found in other industries. The meetings of the American Welding Society's industrial research committees attest to the live interest in the problems affecting welded fabrication.

While research has pointed the way or corroborated evidence seemingly apparent, the solution of problems occurring from day to day also depends upon the man running the arc. It is his attention to details and variables from bead to bead or weldment to weldment that will help in overcoming the difficulties. Management must maintain and encourage this interest for herein lies the ability to do work at a profit. The engineer can supply the fundamental knowledge which the welder needs or correlate the experiences to find the trend of circumstances as a means of predicting the results; and the more information that is put into the hands of the welders the better are the possibilities of securing satisfactory work.

In the discussion of problems having to do with welding, although certain details as to the method of carrying out the investigation must be given, it is suggested that the fundamental ideas relating to that particular problem be given precedent over the mere routine of conducting the procedure or assembly. By doing this, the association of significant and relevant points may be applied to the problem in hand, even though the weldments themselves may differ widely in appearance or purpose. In other words, the building of a welded ship presents a problem in itself and requires years of study and experience to do the work successfully in the design, laying out, assembly and joining; yet there are only a few who would be interested, and a lesser number who could understand the general procedure. However, there are many specific problems encountered in ship welding which, if taken apart from the whole, would be extremely helpful and indeed applicable to the general trade. For example, some of the means employed to reduce the amount of warping, so important to a ship's lines and compartments, could be applied to many jobs, wherein the component parts, small in themselves, could be handled in like manner, even in the smallest shop.

Effect of Stress Relieving

The effect of stress relieving on welded structures is undoubtedly of interest to most everyone concerned with welding and is a subject of study that is being made by many investigators. The stress relieving treatment is certainly beneficial to the welded vessel although, depending upon the service, may not always be necessary. Certain results are obtained by this heat treatment, and in this paper some of those effects are reported together with a description of the method of making the determinations.

Two sets of welded specimens were

prepared by two different welding processes. One plate specimen was welded by the ordinary hand welding method using covered electrodes and depositing multiple beads, the other specimen was welded by an automatic process depositing the weld in one pass. Each set was made up of two low-carbon, structural grade, rolled, steel plates beveled, tacked and butt welded together. The rolled plates used to make up the specimens were left in the as-rolled condition prior to welding even though the stresses remaining in the plates due to rolling might have some effect on the final results. In the particular experiment, the greatest interest was centered in the conditions which would be met in actual shop practice where it would not be economical or necessary to heat treat the plates as received from the mill.

Each plate used in these experiments was 36 x 12 x 7/16 in., making up a two-plate welded specimen 36 x 24 x 7/16 in. After beveling to a 45 deg. angle, the plates were tacked and welded together. In the hand welded specimen, the plates were not restrained, but were allowed to assume a free shape on cooling. The automatically welded plates were clamped to the backing bar assembly.

Small tapered holes were drilled into both surfaces of the plate directly opposite each other through the thickness. These holes were spaced 2½ in. apart in two directions; one set of holes running parallel to the weld and the other set at right angles to the weld. There were four series of these holes on the specimen in the direction transverse to that of the weld: one series near each end, one in the middle and one at the quarter point in the length of the specimen. The holes were so laid out that for any hole on one surface there was a hole directly beneath it in a corresponding series on the opposite surface of the plate. The hand welded specimen with the location of the holes in relation to the weld is shown in Fig. 1.

After the welds were made, the distance between holes was measured on both sides of the plate by the use of a strain gage reading to 1/10,000 in., and the average of the two faces recorded. When both surfaces of the specimen had been measured, the plate was cut into sections, the length of which was transverse to the direction of welding. Each strip was 3 in. wide and 24 in. long and contained one series of two rows of holes on each of its two surfaces. The distance between holes in both directions was measured on the cut strips and the average of both faces compared with the average obtained before the strips were removed. The difference between these figures gave the change in length in units of 1/75,000 in., and, based on the modulus of elasticity, each unit represented 400 lb. per sq. in. While the quantitative difference in the averages showed the amount of residual stress, the sign of this difference indicated the direction of the stress. A negative value meant a shortening of the area being measured, or tension; whereas, a positive result showed a lengthening, or compression.

The values obtained for the automatic weld and the sign of the stresses are plotted as shown in Fig. 2, where the readings parallel to the weld were recorded. Since only the middle series of holes, curve "C," was measured through the weld, it is the only complete curve; although the other curves may be completed from the direction of the lines already drawn. The maximum residual stress found occurs in the middle of the weld along the center-line where the value of 46,000 lb. per sq. in. is shown. Moving away from the center-line of the weld, the stress measured in increments of ¼ in. over the 2½ in. span of the strain gage, the stress drops off at the outer edge of the weld to an average value of 41,000 lb. per sq. in. at the fusion line.

The physical values of an all-weld metal specimen in the as-welded condition are as follows: 66,000 lb. per sq. in., tensile strength; 49,000 lb. per sq. in., proportional limit; 22.5 per cent, elongation in 1 in.; and 37.2 per cent, reduction in area.

The value of the stress relieving treatment as a means of reducing the residual stresses is demonstrated by the curves in Fig. 3, as compared with the as-welded specimen in Fig. 2, just described. This plate after welding was stress relieved at 1150 deg. F., and held at that temperature for

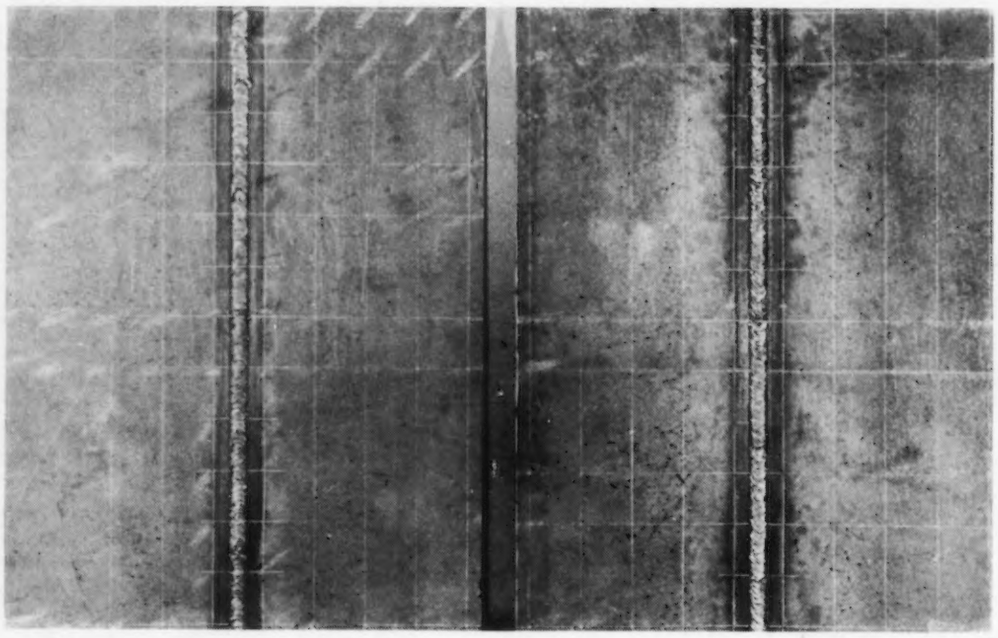

FIG. 1—Hand welded plate specimen showing location of holes used in measuring residual stresses. The holes are 2½ in. apart in the four series of lines across the weld.

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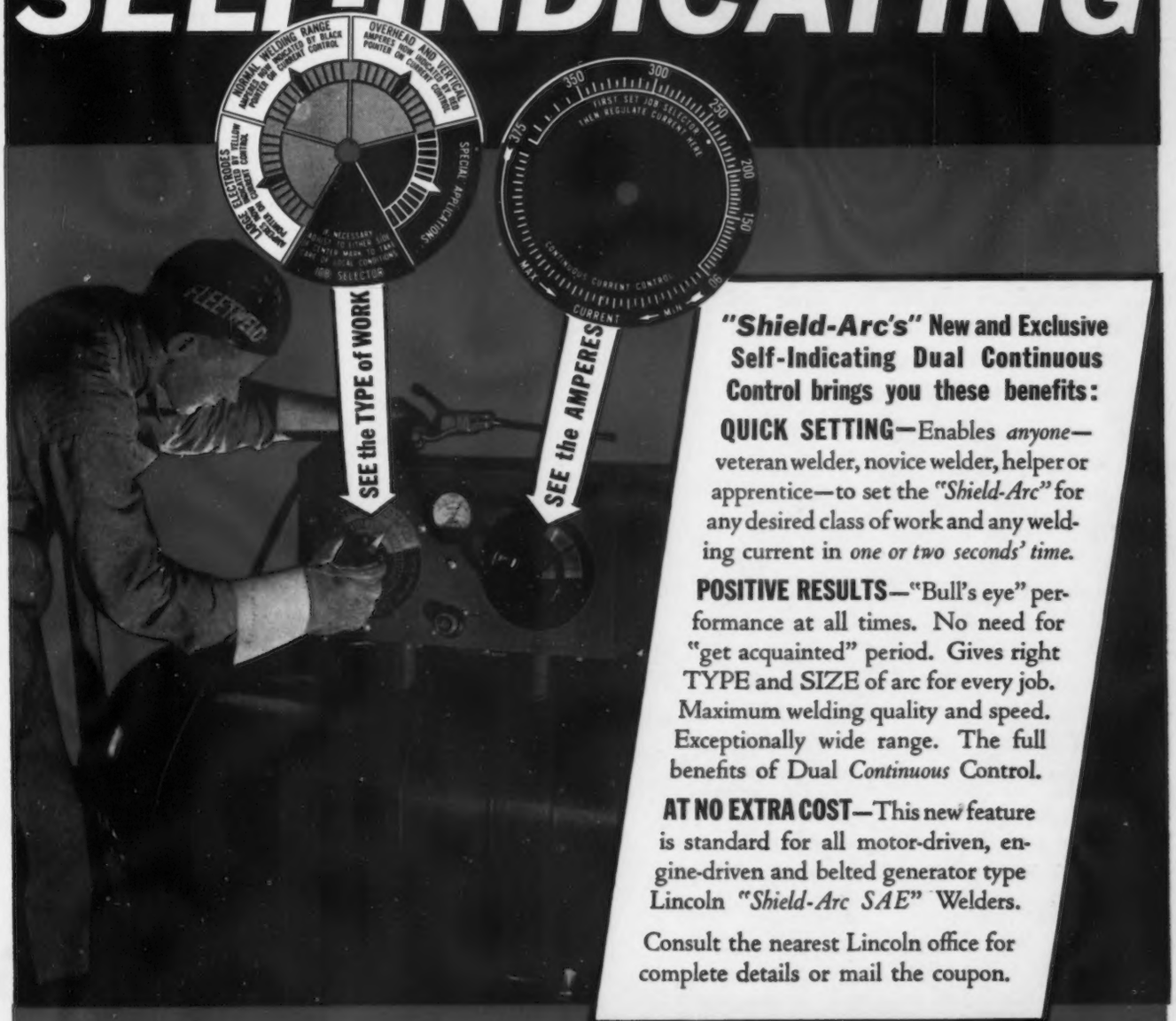

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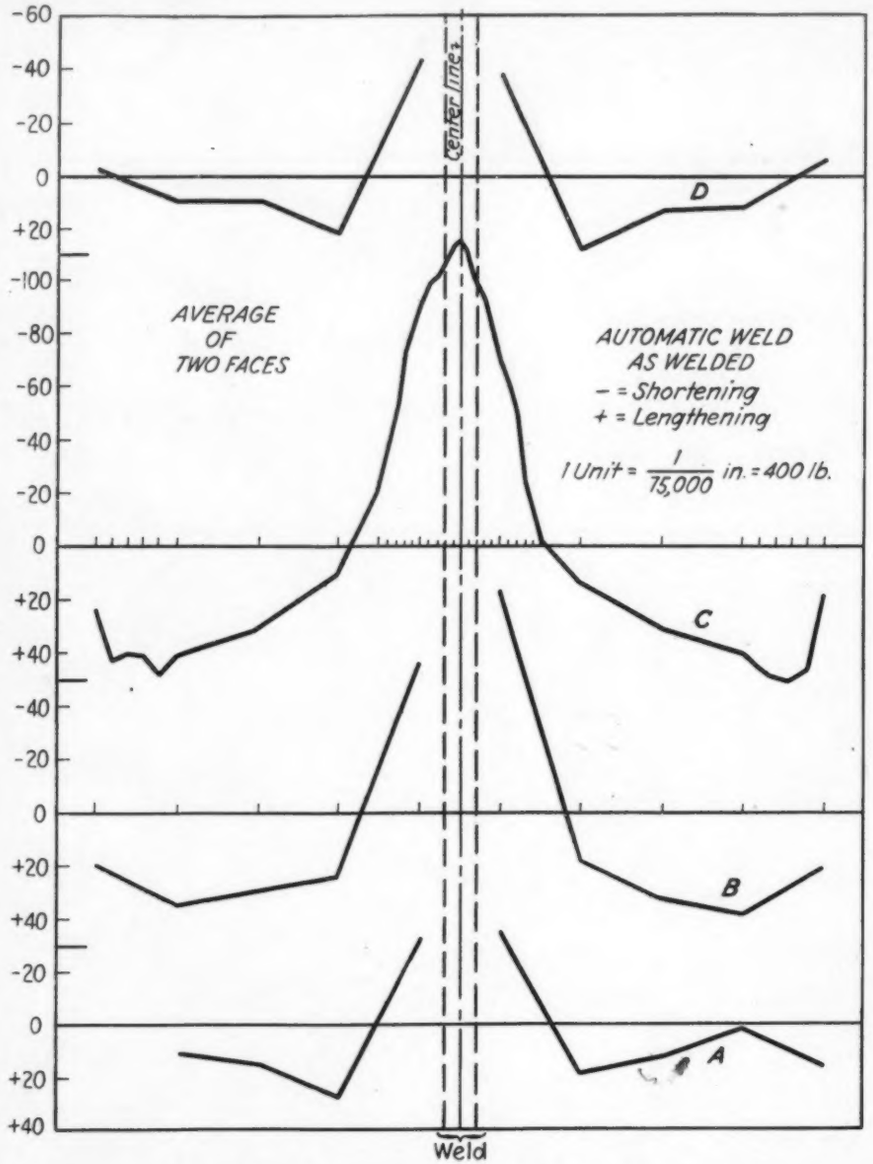

FIG. 2—Residual stress measurements in the as-welded condition for the four lines. The maximum stress of 46,000 lb. per sq. in. appears at the center-line of the weld.

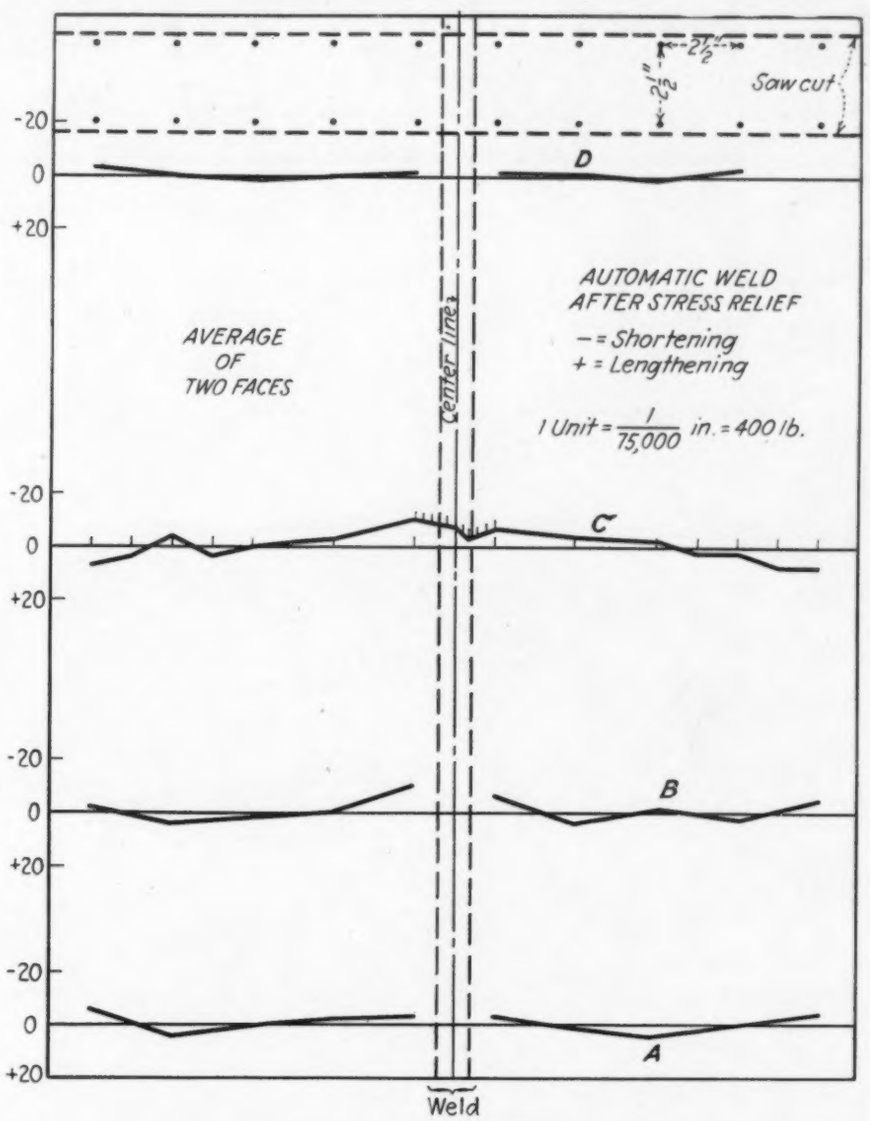

FIG. 3—After stress relieving at 1150 deg. F., the stress has been reduced to 4000 lb. per sq. in.

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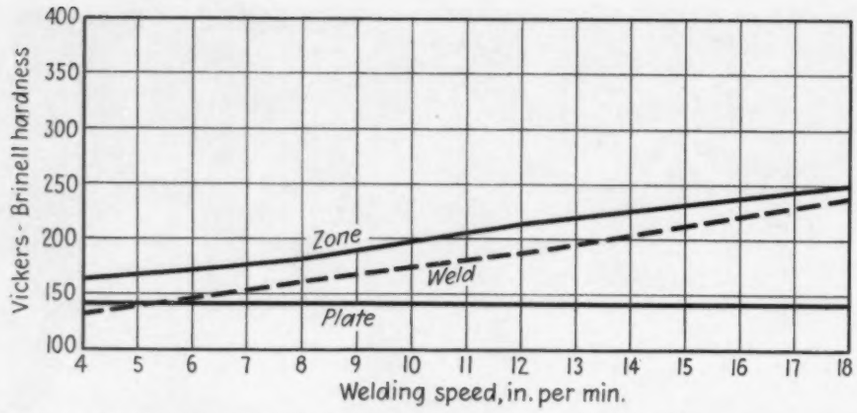

FIG. 4—SAE 1035 steel (0.33 per cent carbon) welded with a constant current (375 amp.) and constant potential (23 volts). Maximum hardness 250 Brinell in as-welded condition.

30 min. in accordance with the standard practice of heating and cooling for this treatment. The values plotted on these curves were obtained in the same manner as for the as-welded specimen.

For the complete curve, curve "C," where the measurements were taken at intervals of ¼ in. through the weld and affected zone of the plate, the maximum residual stress in the stress relieved specimen is 4000 lb. per sq. in., as compared with the same location in the as-welded specimen showing 46,000 lb. per sq. in. The other curves for indentical positions are reduced in like manner.

The studies made on the hand welded specimens showed similar results and checked the efficiency of the stress relieving treatment.

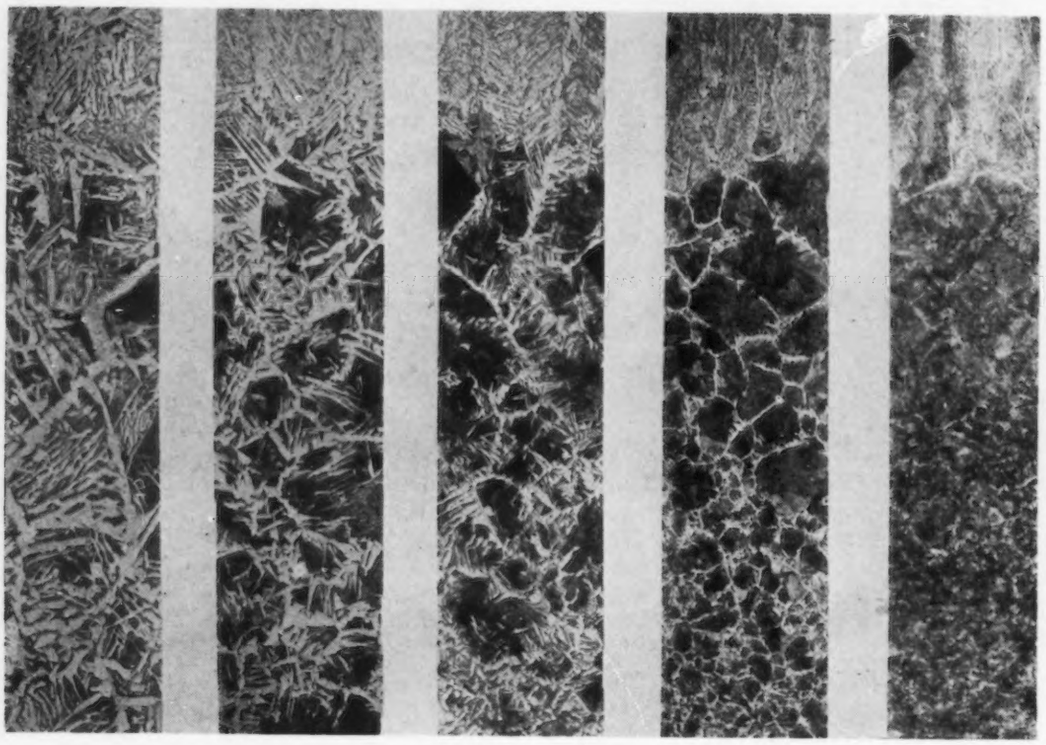

FIG. 6—SAE 1035 steel as-welded. At 150 diameters. Photomicrographs of the weld and hard zone for the five welding speeds of 4, 6, 8, 12 and 18 in. per min. Structure ranges from large grained pearlite to sorbite.

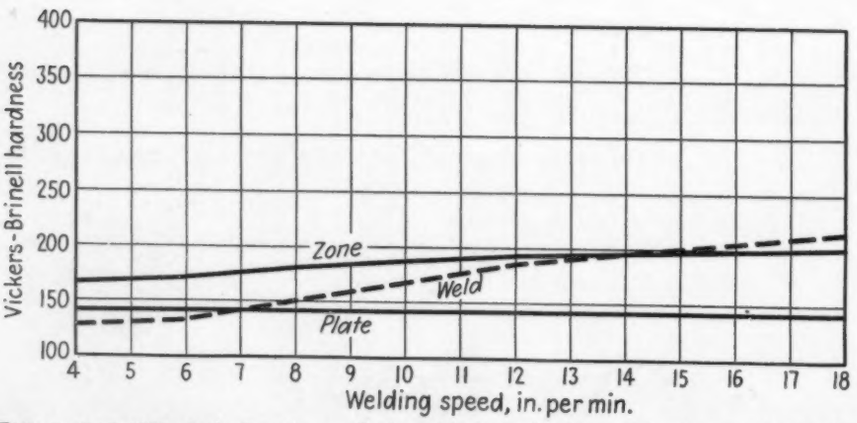

FIG. 5—SAE 1035 steel after stress relieving. Maximum hardness of hard zone 200 Brinell.

A further example of the effect of stress relieving is found in the reduction of hardness in the heat-affected plate metal adjacent to a weld and the change in microstructure resulting from this treatment when the original structure is of a higher order than sorbite. The writer has described in THE IRON AGE, under dates of Oct. 15, 1936, Dec. 17, 1936, Feb. 25, 1937 and March 4, 1937, in a paper entitled "Heat Effect in Welding," the effect of welding on the base metal adjacent to the weld. The welding process itself produces a heat treatment in the

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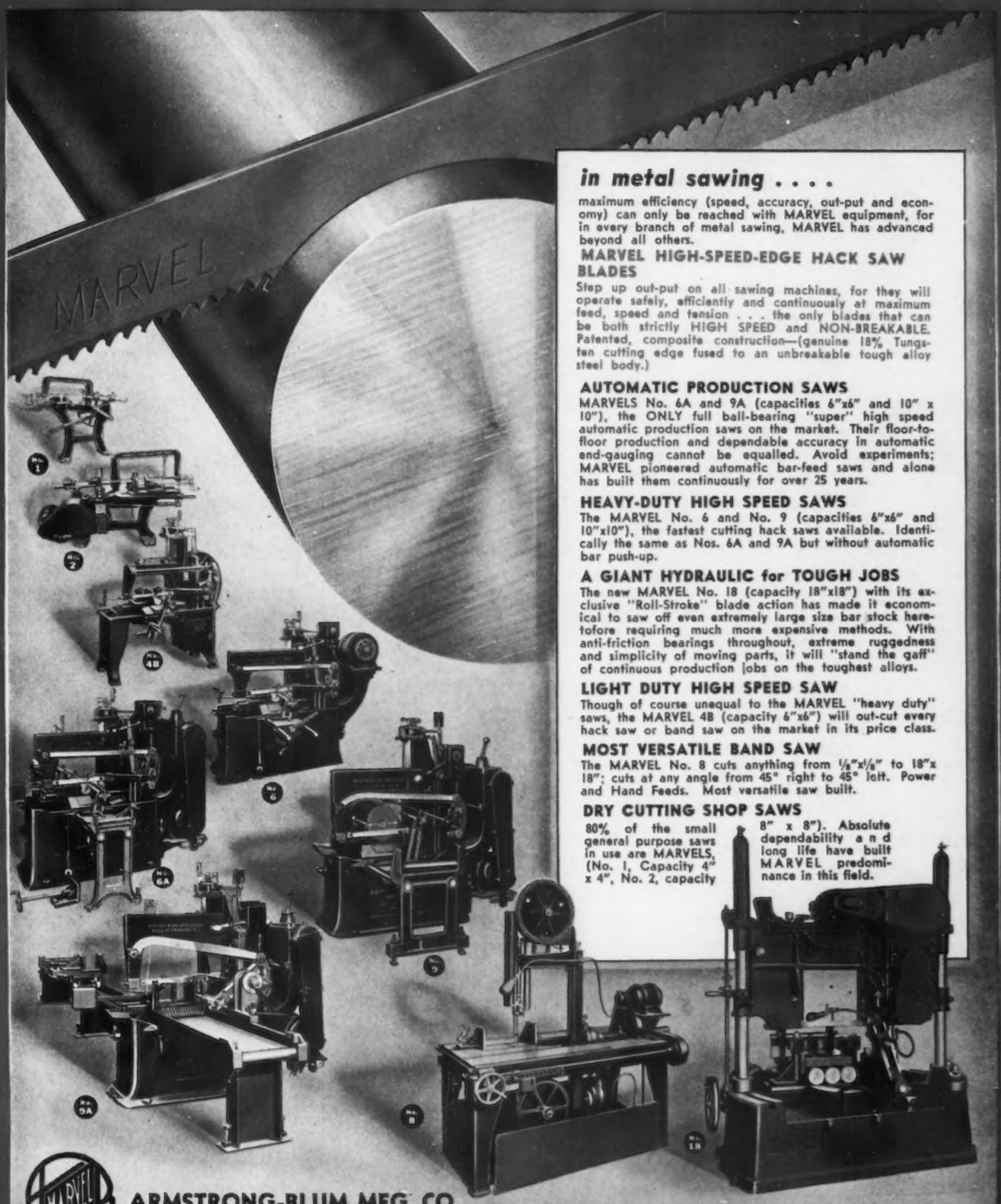

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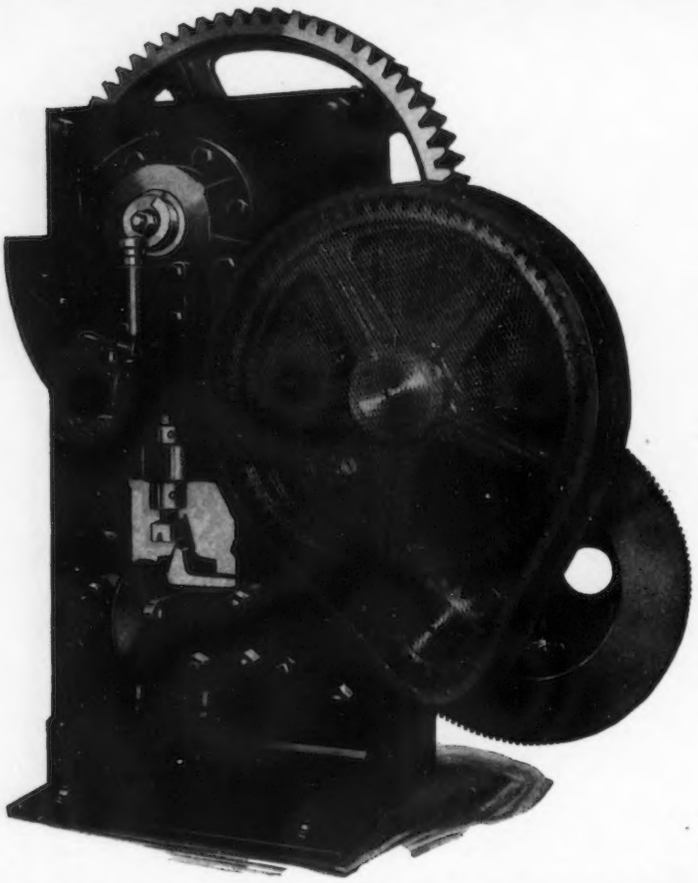

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base metal by the heat developed at the arc in depositing the bead. This heated section, being above the critical range, becomes hardened by the quenching action of the adjacent base metal as the heat of the weld is conducted into the surrounding plate. As the speed of welding is increased, the rate of quenching becomes greater and the hardness of the heat-affected zone increases.

A structural grade of steel, SAE 1035 containing 0.33 per cent carbon was welded by depositing a bead on the top surface of a ½-in. thick plate at welding speeds from 4 to 18 in. per min. The current values were held constant, as were also the plate dimensions and the chemistry of the material. Cross-sections were cut through the welded samples, which then were polished, etched and Vickers-Brinell hardness impressions run across the weld and hard zone as well as the unaffected portion of the plate. The hardness values for the hard zone, weld and plate are plotted as shown in Fig. 4. In this particular specimen the hard zone varies from 162 Vickers-Brinell at 4 in. per min. to 250 at 18 in. per min.; the plate, of course, remaining throughout at 140. Thus, the range in hardness in the zone itself is 88 points and the maximum spread between the plate and the zone at the highest speed is 110 points. This is not a hardenable steel to an extent which places it beyond a structural use.

Stress relieving this set of specimens reduces the hardness somewhat as shown in Fig 5 where the range in the hardness of the hard zone is 33 points, from 167 to 200 Brinell, and the spread between the maximum hardness at 18 in. per min. and the plate metal is from 140 to 200, or 60 points. The greatest hardness has been reduced 50 points Brinell, but the low values have not been affected. This is to be expected in view of the fact that the low values are already in the softened condition and any further heat treatment can have no additional effect in this direction. The ability of the stress relieving treatment to reduce the hardness of the hard zone becomes more pronounced in proportion to the original hardness of the as-welded samples.

The microstructure of the as-welded specimens, Fig. 6, for the five welding speeds shows large-grained pearlite at the slower speeds to fine-grained sorbite at the higher speeds.

(TO BE CONCLUDED NEXT WEEK)

Influence of Cutting Fluids on Metal Cutting

o o o

By FRANK J. OLIVER
Associate Editor, The Iron Age

o o o

CLAIMING no originality, the author has been kibitzing over the shoulders of Prof. O. W. Boston of the University of Michigan and his co-workers on the Special Committee on Cutting of Metals of the American Society of Mechanical Engineers in an attempt to summarize in readily understandable terms and in as objective a manner as possible 10 years of painstaking research work, including the results of some recent tests, hitherto unpublished. Besides bringing to light in the form of a correlated report some usable information for the production engineer, Mr. Oliver has also traced through the years the accumulation of scientific proof that the chief attribute of a cutting fluid is to cool the tool and work, rather than to act as a lubricant at the point of contact. Except for Professor Boston's own presentation before the Institution of Mechanical Engineers in October, 1937, at London, in a paper on Cutting Fluids, no attempt has heretofore been made to summarize the results of the research to date, nor has any one not closely associated with the original studies tried to evaluate their practical importance from the point of view of industrial application.

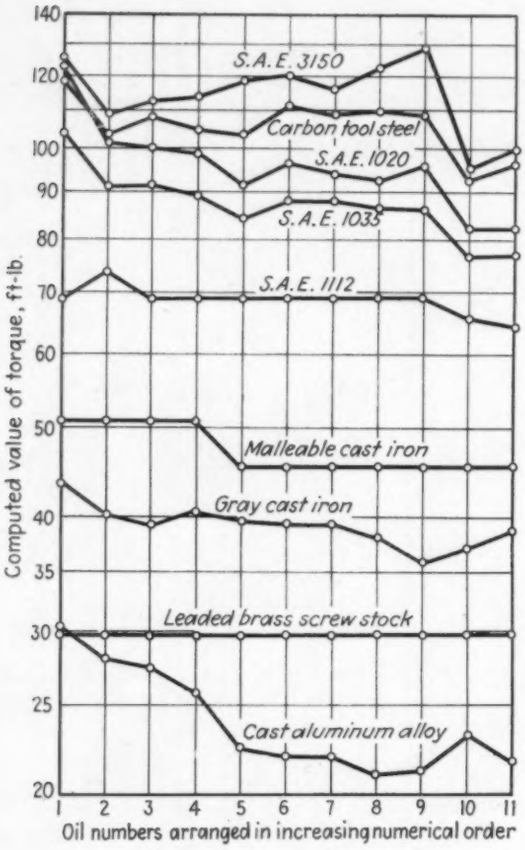
o o o

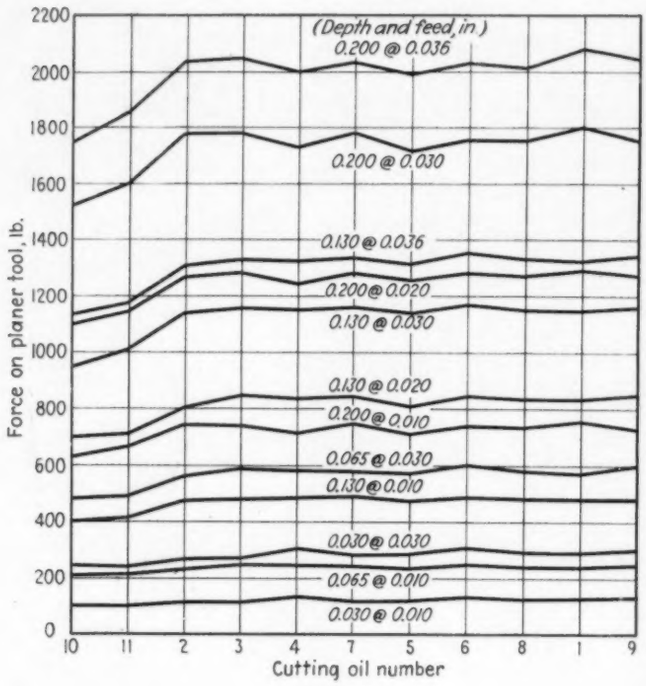
IN order to produce at the least unit cost the greatest production of a part having definite analysis, structure and physical properties, the cutting tool should obviously be of a material of suitable type and geometric shape as determined by its profile of cutting edge and combination of angles. The cutting fluid should have properties best suited to obtain the highest rate of production with reasonable tool life, the best surface finish and the most convenient chip form for disposal. If the physical properties of the metal cut are changed, or if another metal is substituted, some of the factors of the tool, cutting fluid or mechanical equipment should be changed to maintain the optimum cutting conditions. The present state of the art of metal cutting leaves the selection of these various factors for each problem to be determined largely by empirical methods and experience, since the scientific study of any one factor entails years of research.

What this article will attempt to do will be to review some of the fundamental research work done in recent years in observing the influence of cutting fluids and interpret it in practical conclusions that should find application in actual shop practice. Specifically, we will confine this review to an appraisal of the work done by the Special Research Committee on Cutting of Metals of the American Society of Mechanical Engineers, much of it at the engineering laboratories of the University of Michigan under the direction of Prof. O. W. Boston, chairman of the Department of Metal Processing, and his associates. Research of this kind carried out under scientifically controlled conditions is necessarily slow and laborious, and out of a welter of data accumulated through years of effort a mass of conclusions and statistics appears that is often confusing to the average shop engineer. Like most fields of research, the area explored by infinite pains is microscopically small compared to the innumerable variables met today in the form of newer materials and cutting alloys. One can see, however, that the choice of cutting fluids has been narrowed by the Committee as time went on.

Criticism has been directed against some of the work on the basis that it did not simulate actual working conditions, but this charge does not hold for the simple operations of turning in a lathe or drilling and it is work along the last named lines that will be principally reviewed.

The work of the Sub-Committee on





AT LEFT

FIG. 1—Comparison of torque required to drill ferrous and non-ferrous metals with a 1¼-in. drill and 0.015 in. per rev. feed and various cutting fluids listed in Table I by number.

ABOVE

FIG. 2—Force required to plane SAE 3150 steel at the various depths of cut and feeds indicated on each curve and using the cutting fluids (listed by number in Table I) in the order of increasing tool force.

Cutting Fluids of the A.S.M.E. began about 10 years ago.[1] The U. S. Bureau of Standards cooperated in this report by sending out a questionnaire to a group of leading manufacturers. The replies that came in indicated complete confusion and disagreement as to best practice and widely divergent views as to what a cutting fluid was supposed to do. That question has yet to be settled and only in the very latest tests does the theory begin to be substantiated that it is the cooling action rather than the lubricating action that is dominant. But more of this later.

As a result of the first rough check, a more formal survey was made by questionnaire as to then current shop practice. The returns from 75 plants were tabulated and presented in a second progress report[2] in December, 1929, but no conclusions were drawn by the Committee. At best the report indicated again that practice varied widely: on a simple operation of rough turning low carbon steel, for example, 17 companies did the cutting dry, 27 used water emulsions, mostly of the water plus mineral oil-soap variety, and 19 used oils or oil mixtures, mostly compounded oils, with or without sulphur.

The First Tests

With funds from the Engineering Foundation, the Sub-Committee then undertook a specific study to determine the influence of 11 different cutting fluids on the power required to plane and to drill annealed SAE 3150 steel. The limited funds available did not make it possible to carry the tests further and determine the influence of cutting fluids on tool life. The results of this study, published as Progress Report No. 3[3] on cutting fluids, show among other things that the quantity of cutting fluid delivered at the point of a drill influences the value of torque and thrust, as follows: The lowest drilling torque and the lowest drilling thrust for most cutting fluids were obtained when the oil is supplied to the drill point in the greatest quantity. This refers to oil directed to the point through an oil hole in the drill and the conclusion does not hold for large quantities of oil simply dumped on the work above the point of drilling. Another point brought out by these tests is that sulphurized mineral oil or a sulphurized lard-mineral oil gave the lowest value of torque under all conditions, as indicated in Fig. 1. The fact that borax water gave the third lowest torque was one of the earlier indications that the cutting fluid exerts primarily a cooling influence rather than one of lubrication. An oil compounded of 5 per cent oleic acid in light mineral oil produced a torque slightly greater than when cutting dry and hence showed the highest torque of any cutting fluid in the group. As might be expected, the net horsepower input required to drill SAE 3150 steel appeared to vary for the different oil specifications in exact

[1] Report No. 1 of the Sub-Committee on Cutting Fluids of the Special Research Committee on Cutting of Metals of the American Society of Mechanical Engineers, entitled "Cooling and Lubrication of Cutting Tools," presented at the Annual Meeting of the A.S.M.E. in December, 1928, at New York.

[2] Progress Report No. 2. "Present Practice in the Use of Cutting Fluids," presented at the Annual Meeting of the A.S.M.E. in December, 1929, at New York.

[3] Progress Report No. 3. "Performance of Cutting Fluids," by O. W. Boston, University of Michigan, and C. J. Oxford, National Twist Drill Co.; presented before the A.S.M.E. in June, 1931, at Hartford.

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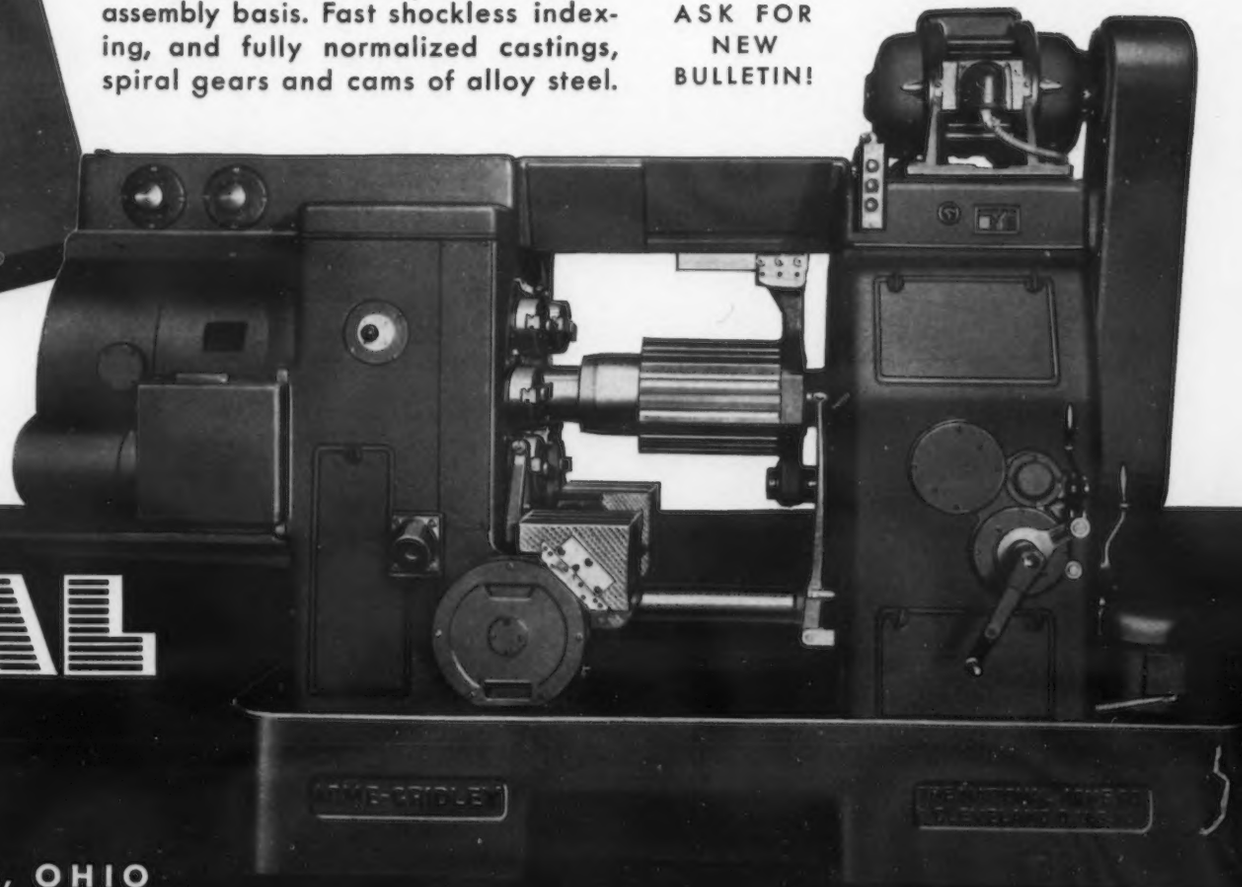

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accordance with the torque values (approximately 99½ per cent of the power is due to torque).

Another test that bore out the coolant contention was one made to determine the lubricating qualities of the various cutting fluids. On a test journal, the sulphurized mineral oil proved to be a poor lubricant, although it did retain an oil film at high pressure.

Planer Tests

When cutting with a planer tool, it was noted that every chip, regardless of the combination of depth and feed, had a built-up edge on the tool point when cutting dry or with any of the cutting liquids used. As Fig. 2 shows, for most of the cutting fluids, too, there is practically no difference in the force required to push the tool through the work, with the exception again as in the case of drilling, the sulphurized oils showed a lower force consistently regardless of chip size.

At the time of the presentation of this report in June, 1931, the authors —Professor Boston and Carl J. Oxford, chief engineer of National Twist Drill & Tool Co.—concluded the abstract of their report with the statement that "it appears that cooling is the primary requisite of a cutting fluid rather than lubrication." Today Professor Boston indicates he is more convinced of this conclusion than ever.

But this is getting ahead of our interpretative story. The fourth progress report[4] was a continuation of the studies made on the performance of cutting fluids as affecting drilling operations, except that the number of metals drilled was increased to nine and included both ferrous and nonferrous materials, both cast and rolled. The same eleven cutting fluids were used as shown in Table I.

Formulas for the calculation of drill thrust and torque had been developed previously in the form of exponential equations. In these tests it was found experimentally that the value of these exponents remained the same regardless of the diameter of the drill, when the feed is varied, or regardless of the feed when the drill diameter is varied. When plotted on double logarithmic paper (log-log) these formulas can be plotted as straight lines, and with constant exponents, the lines are parallel but are displaced vertically according to whether feed or diameter is varied.

[4] Progress Report No. 4. "Performance of Cutting Fluids in Drilling Various Metals," by O. W. Boston and C. J. Oxford; presented before the A.S.M.E. in December, 1932, at New York.

TABLE I—CUTTING FLUIDS USED IN THE EARLY TESTS INVOLVING DRILLING, PLANING AND SAWING.

1—Dry cutting
2—1½ per cent borax in water
3—1 part soluble oil in 50 parts water
4—1 part soluble oil in 10 parts water
5—No. 1 lard oil
6—Light mineral oil (111 sec. Saybolt at 100 deg. F.)
7—Heavy mineral oil (209 sec. S. at 100 deg.)
8—10 per cent No. 1 lard oil in mineral oil
9—5 per cent oleic acid in mineral oil
10—Sulphurized mineral oil (4.38 per cent S)
11—Sulphurized lard oil blended with 5 pts. mineral oil

There are certain constants used in these formulas, however, and these are affected by the cutting characteristics of the cutting fluids.

Disregarding this constant for the moment, it was found that the torque formula for all steels was the same, as far as the values of the exponents are concerned, regardless of analysis. The equation takes the form:

$$T = C f^{0.78} d^{1.8}$$

Where T = torque in ft.-lb.
f = feed in in. per rev.
d = diameter of drill in in.
C = a constant depending upon the cutting fluid, the drill and the material drilled.

Formulas are available in the original report for most of the commonly used materials and cutting fluids and are useful to designers of drilling machinery.

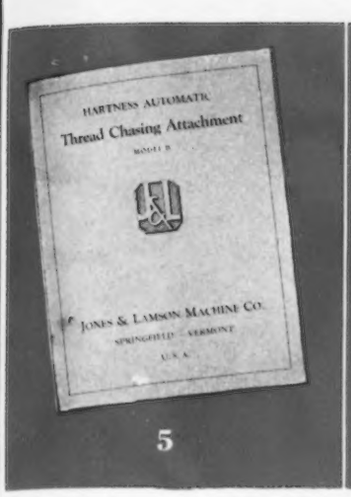
What we should particularly like to point out at this time is the influence of the different cutting fluids on each metal—in other words, the effect on the constant C in the torque formula. With the net output power for drilling dry expressed as the index number 100, the savings made in power by the use of the most suitable cutting fluid for that particular material are as follows:

Material	Optimum Cutting Fluid	Per Cent Saving in Power Over Drilling Dry
SAE 1020	Sulphurized oil	33.3
SAE 1035	Sulphurized lard-mineral oil	26.0
SAE 3150	Sulphurized mineral oil	23.0
Carbon tool steel	Sulphurized mineral oil	21.0
Cast iron	Mineral oil with 5 per cent oleic acid	17.2
Malleable cast iron	Any kind of oil	10.5
SAE 1112 Bessemer screw stock	Sulphurized lard-mineral oil	6.8
SAE 33 Aluminum alloy	90 per cent mineral—10 per cent lard oil	31.7

No appreciable difference is found for free-cutting brass whether cutting dry or with any kind of cutting fluid.

Why sulphurized oils are superior for drilling steel is still a matter for conjecture. Obviously the condition of the sulphur in the oils, whether it is chemically active or in a chemically inactive state has a great deal to do with its resultant performance. It is not definitely known, however, what the complete purpose is of the cutting fluid, with or without sulphur, so it appears that much work remains to be done before a complete understanding of metal cutting can be had and the application of cutting fluids put on a scientific basis. (The above was part of the authors' closure, following the discussion of Report No. 4, published in 1933). On the tests of cutting fluids as a bearing lubricant, it was found that sulphur in plain mineral oil permits the generation of considerable friction and heat, but prevents seizure of the bearing, although from the standpoint of friction torque it measured up as a poor lubricant. A sulphurized lard-mineral oil showed better results on this score, probably because the fat in the lard oil reduces the friction. This characteristic represents the main difference between the blended sulphurized base oils and the sulphurized plain mineral oils.

As an aside at this point of the historical review, it might be well to mention that other experiments on the turning of metals have led Professor Boston to believe that tool life in turning is a direct function of the temperature at the tool point so that it would be expected that the cutting fluid having the highest cooling property would produce the longest tool life. At the same time it is reasonable to expect that an oil, as a result of its lubricating properties, might reduce the heat generated at the tool point, and even in spite of its lower thermal conduc-



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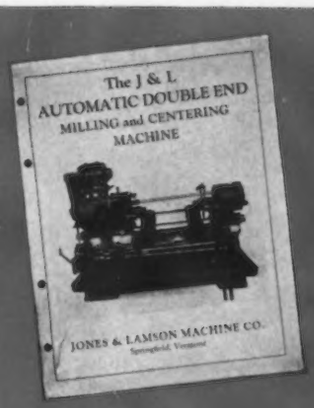

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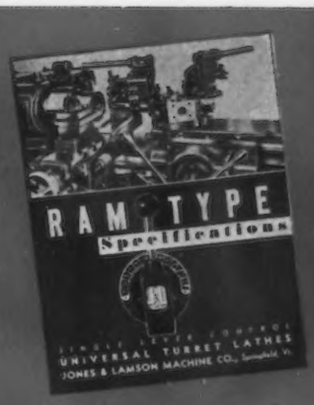

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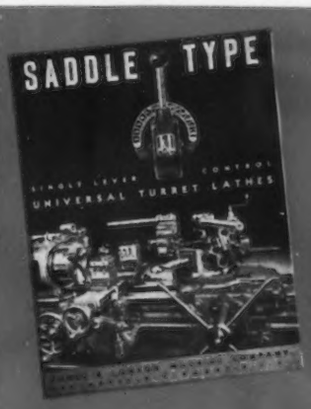

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tivity, keep the temperature at the tool point lower than when the better refrigerant is used. Some experimental data confirm this belief, but other data tend to disprove it. Evidently lubrication and thermal conductivity are both of importance and the weight of the influence of these factors varies for different applications. The most recent data, however, tend to confirm the belief that the cooling effect predominates.

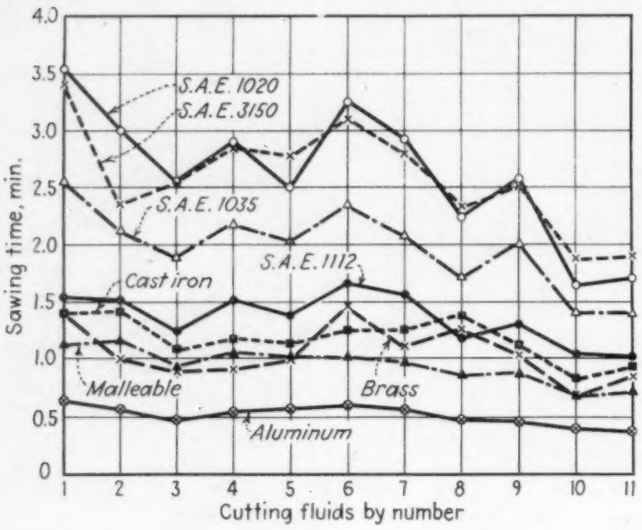


FIG. 3—In sawing through a 1½-in. sq. section of each of eight different metals with a high speed steel blade in a power hacksaw, in every instance, the sulphurized mineral oil, No. 10, was found to be the best in that its use resulted in the shortest sawing time. The cutting fluid numbers are identified in Table I.

Sawing Tests

The fifth progress report[5] on cutting fluids dealt with the performance of cutting fluids when sawing various materials, in fact the same eight ferrous and non-ferrous metals that were subjected to drilling tests the year before. The time required to saw through a 1½-in. square section of each metal was used to measure the performance of the cutting fluids, which were the same 11 previously used in other cutting fluid tests. Constant speed (120 strokes per min.) and constant feed pressure (119 lb.) were obviously employed, and the hacksaw blades were used in a Peerless 9 x 9-in. power sawing machine.

These comparative tests showed for one thing, that the cutting times, when sawing aluminum, malleable cast iron, cast iron and brass, varied but little for the various cutting fluids. The greatest variation in cutting time was obtained when cutting the four steels in the group. But for all the metals sawed, the sulphurized mineral oil proved to be the best, although in the example of aluminum and the other cast materials, the reduction in cutting time over dry cutting was relatively slight. Fig. 3 is plotted from these test data. In the example of SAE 1020 steel, however, the gain was marked—a drop from 3.55 min. dry to 1.65 min. with a sulphurized mineral oil as a lubricant, a gain of 116 per cent if we consider it from the point of view of production or the number of cuts made per hour under each condition. In the example of bessemer screw stock, SAE 1112, on the other hand, the gain was only 46.5 per cent on production, and the sulphurized lard-mineral oil showed a slightly better performance.

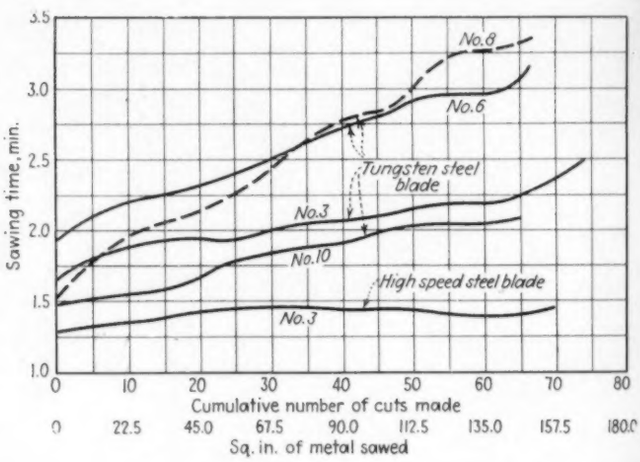


FIG. 4—Relative wear on hacksaw blades when cutting 1½-in. square sections of SAE 1112 bessemer screw stock. Cutting fluids are designated by number in Table I. For the tungsten steel blade (14 teeth per in.), the sulphurized mineral oil, No. 10, is most advantageous from a wear point of view, and the blended lard-mineral oil is the worst.

Rate of Wear on Blades

It was also apparent from these tests, which included some comparative tests on tungsten steel blades as against high speed steel blades, that cutting fluids appreciably affect the rate of dulling of hacksaw blades (Fig. 4). The least wear was obtained with the sulphurized mineral oil, while the greatest wear was found with a light mineral oil containing 10 per cent lard oil. Oddly enough, this is the same compounded oil that in the drilling tests gave the greatest saving in power when drilling aluminum alloy SAE 33. (In the sawing time tests, this same cutting fluid did not show as good a performance in cutting aluminum as did the sulphurized mineral oils, either straight or compounded with lard.)

In the comparative wear tests, obviously the tungsten steel saws showed the greatest wear at the end of the tests (65 cuts) and had shown an increasing length of time for each cut, but here again the sulphurized mineral oil proved to be the most advantageous. The high speed steel blade showed no appreciable increase in time of cut from first to 65th cut and gave no visible indications of wear.

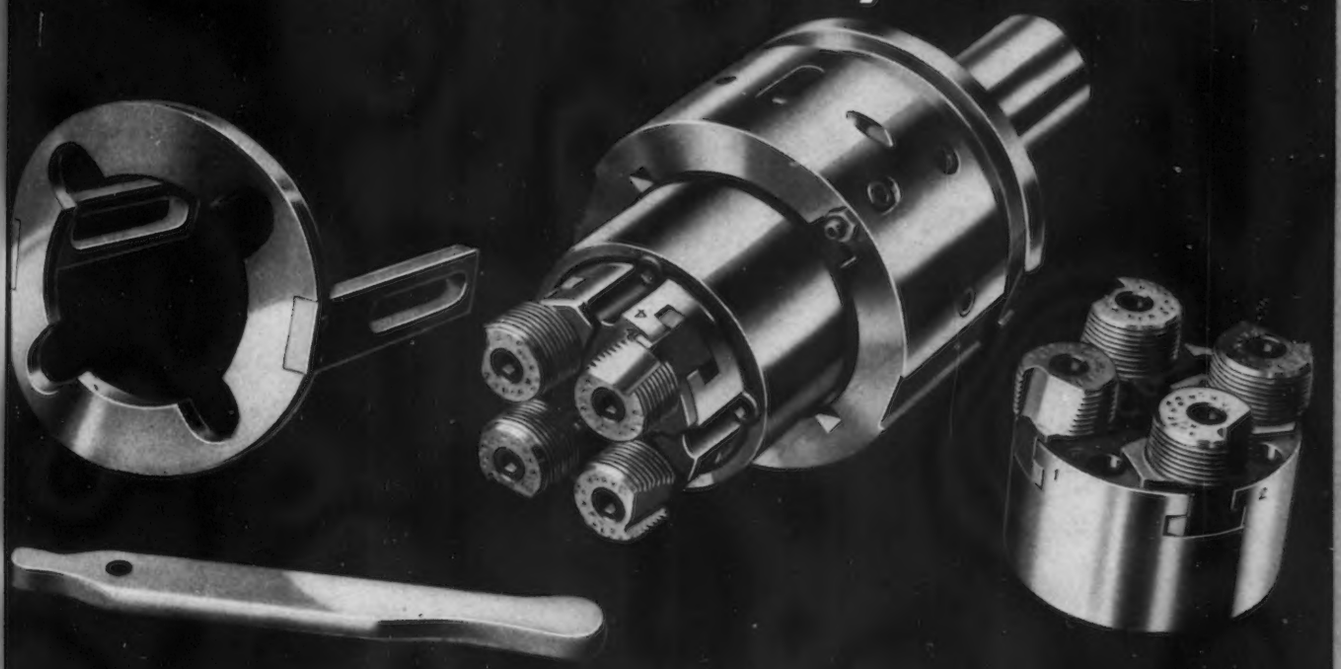
Incidentally, these particular tests showed that the 1:50 soluble oil emulsion in water gave a better performance from a wear point of view than did a light mineral oil, besides producing faster cutting. This appears to be another indicator that it is the cooling property of cutting fluids that predominates, rather than its value as a lubricant. The presence of sulphur in a mineral oil reverses any conclusions in the above respect, however, and leaves the whole question of the role played by what might be termed colloidal sulphur still very much up in the air.

The Question of Tool Life

In the sixth report of the Sub-Committee on Cutting Fluids of the

[5] Progress Report No. 5. "Performance of Cutting Fluids When Sawing Various Metals," by O. W. Boston and C. E. Kraus, University of Michigan; presented before the A.S.M.E. in December, 1933, at New York.

THE ANSWER IS POSITIVELY, YES!



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A.S.M.E.,[6] the researchers, who were again Professor Boston and his associates at the University of Michigan, turned their attention for the first time to the question of tool life as related to the influence of cutting fluids in turning alloy steels. A standard ⅜-in. square high speed steel bit was used in all tests, ground with an 8-deg. back rake, 14-deg. side rake, 6-deg. front clearance, side clearance and end cutting angle, 15-deg. side cutting angle and 3/64-in. nose radius.

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FIG. 5—Form of high speed steel tool bit standardized for steel and monel metal turning tests, and designated as shape 8-22-6-6-6-15-3/64 R; that is, an 8-deg. back rake angle, 22-deg. side rake, 6-deg. side and end clearance and 6-deg. end cutting angles, a 15-deg. side cutting-edge angle and a 3/64-in. nose radius.

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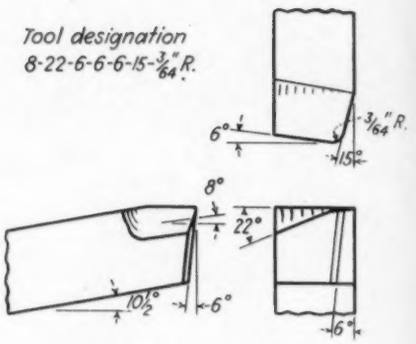

The tool is illustrated in Fig. 5. So as not to prolong the test unduly and to keep down power and material costs, as is the practice in all life testing work, the tests were accelerated. That is to say, many of the cuts were made in a lathe at such a speed that the tool life as indicated by the sudden breaking down of the cutting edge, varied between 1 and 100 minutes. The relationship between tool life and cutting speed as thus determined experimentally can be expressed in the form of an exponential equation (similar to the drill torque formulas previously discussed), and when plotted on log-log paper these "curves" become straight lines that can be extrapolated into the region of commercial practice, where tool life becomes a matter of hours rather than minutes.

[Oddly enough, all life testing data can be resolved into equations of this form, including life test data on such diverse products as ball bearings and electric lamps. The order of the exponents vary, of course.—Author's Note.]

For cutting tools, the tool life formula takes the form:

$$V = \frac{C}{T^n}$$

Where V = cutting speed in ft. per min.

C = a constant, depending upon material cut, tool shape and material, size of cut and cutting fluid

T = tool life in minutes up to time of breaking down of the cutting edge

n = tangent of the angle of the straightline curve when plotted on log-log paper

The value of n seems to be influenced more by the size and shape of the chip than by any other factor. For example, when cutting with a

[6] Progress Report No. 6. "The Influence of Cutting Fluids on Tool Life in Turning Steel," by O. W. Boston, W. W. Gilbert and C. E. Kraus, University of Michigan; presented to the A.S.M.E. in Cincinnati, June, 1935.

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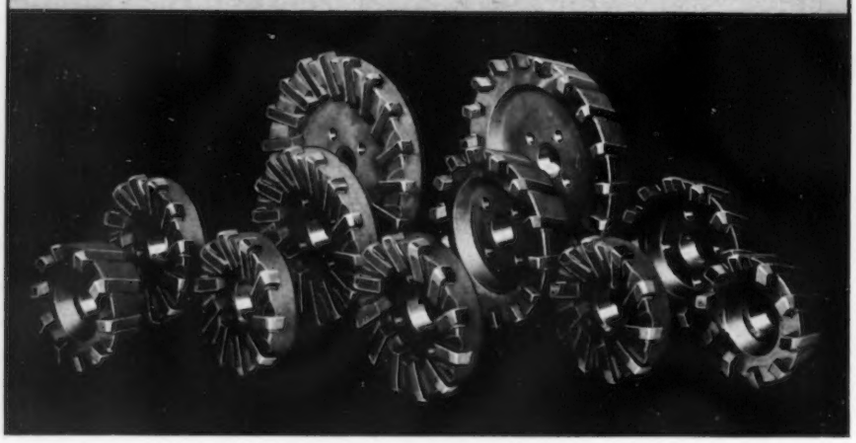

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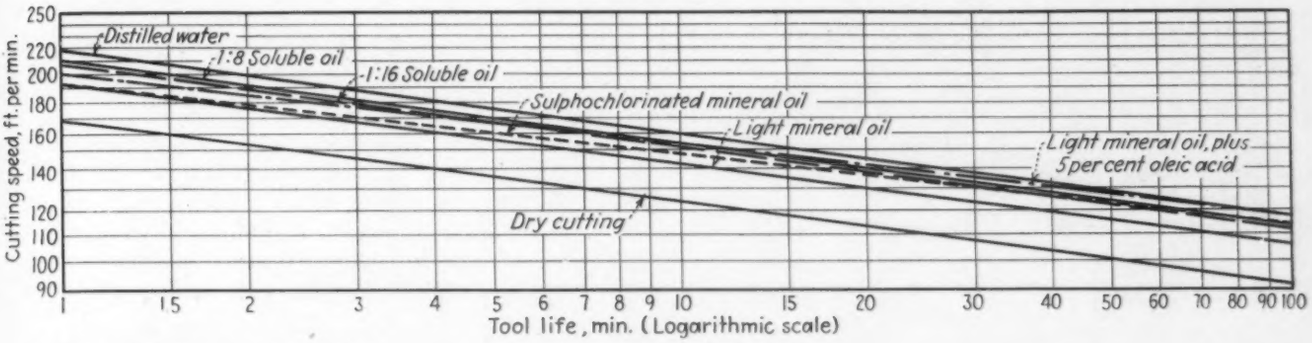

FIG. 6—Cutting speed-tool life "curves" plotted as straight lines on log-log coordinates from test data when cutting annealed SAE 2345 steel, showing the influence of various cutting fluids. Feed, 0.0127 in. per rev.; depth of cut, 0.10 in. Water is shown to be the best fluid from the point of view of the longest tool life at a selected cutting speed; or vice versa, will permit the greatest cutting speed for a selected tool life.

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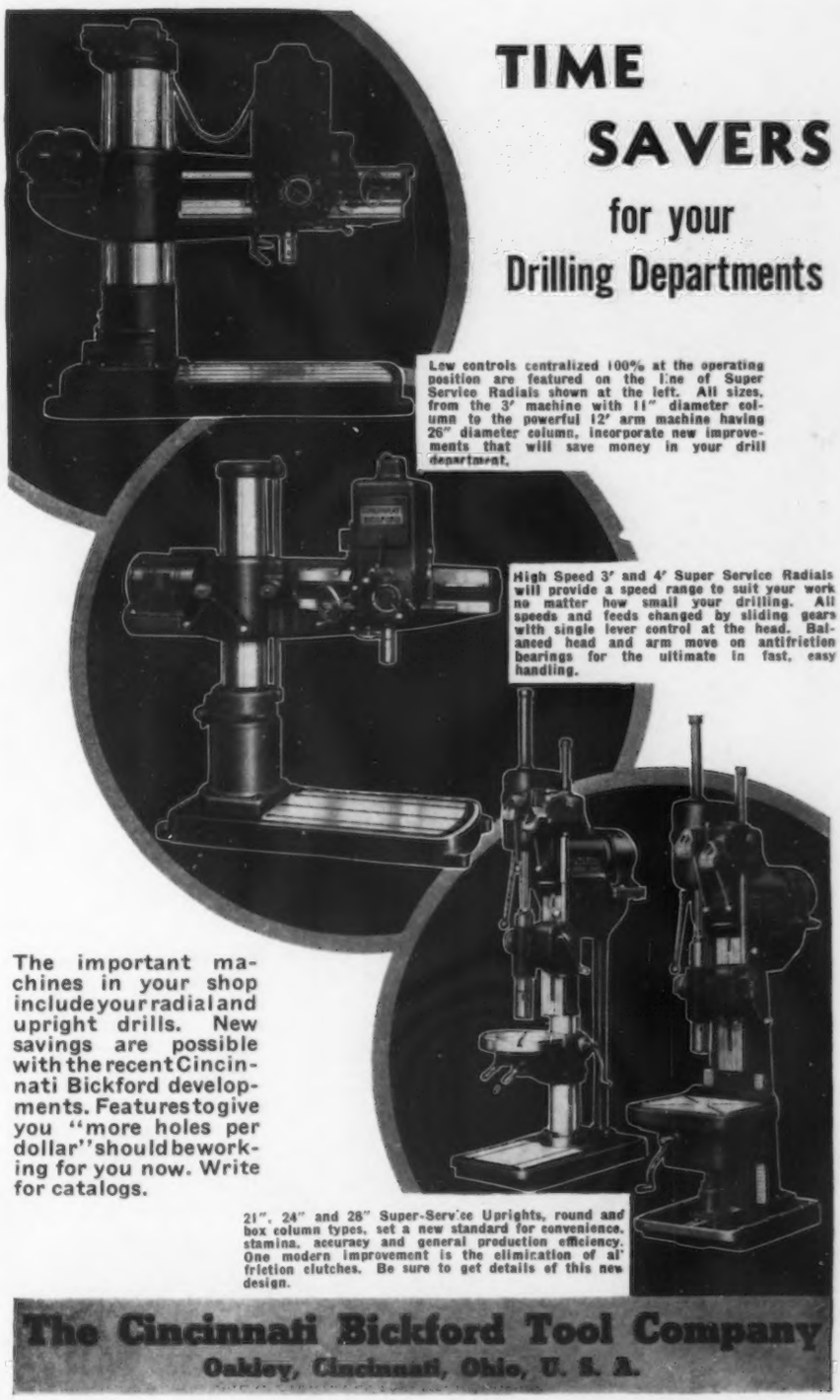
thin, deep chip (feed, 0.0127 in.; depth, 0.10 in.), the tool life line has a lesser slope than those plotted from test results obtained with a thick, shallow chip (feed, 0.0255 in.; depth, 0.05 in.), even when the same cutting oil is used in comparable tests. The practical meaning of this mathematical analysis is that in the case of the thin, deep chip, much larger proportional gains can be had in tool life by reducing the cutting speed by equal increments than for a thick, shallow chip; conversely, if one desired to double the tool life, for example, one would have to reduce the cutting speed by a relatively less amount for the former than for the latter. Fig. 6 illustrates such life curves and will be amplified in reference to the influence of particular cutting fluids—which is the main theme of this discourse.

Taking the tool life of the best performer as far as shape of chip is concerned (thin-deep), and referring to Fig. 6, we see that dry cutting, as would be expected, gives the lowest cutting speed for a given tool life and that plain water, surprisingly enough, gives the highest. For extremely short lives (1 to 15 min.), a 1:15 soluble cutting oil gives the next higher speed, but past the hour endurance limit a mineral oil with 5 per cent oleic acid begins to edge the aqueous solutions out. This trend appears to be reversed, however, in the example of a sulphochlorinated oil used with a thick-shallow chip. (Curve not shown.)

No attempt can be made in a review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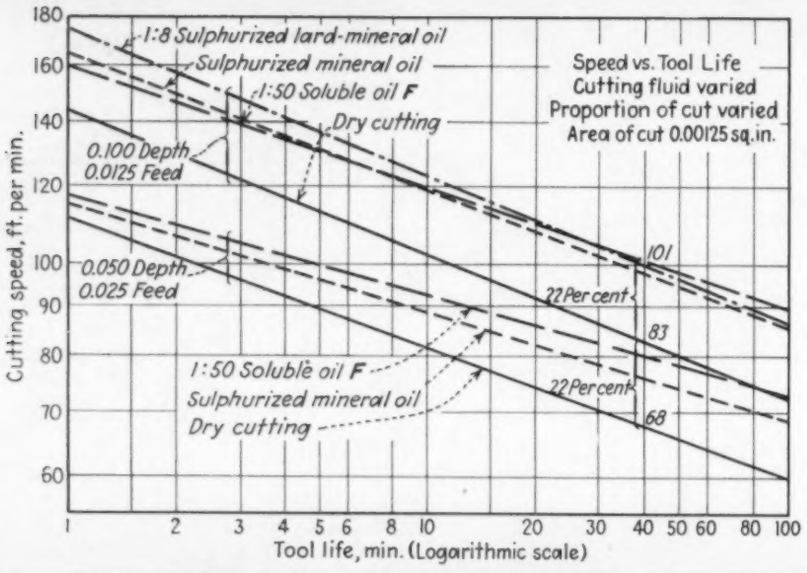

FIG. 9—These log-log curves based on latest test data on turning annealed SAE 3140 steel with two proportions of cut at equal cut area and two cutting fluids indicate that the deep, thin cut is superior; also that at the higher tool lives, the emulsions are somewhat superior to the sulphurized mineral oil.

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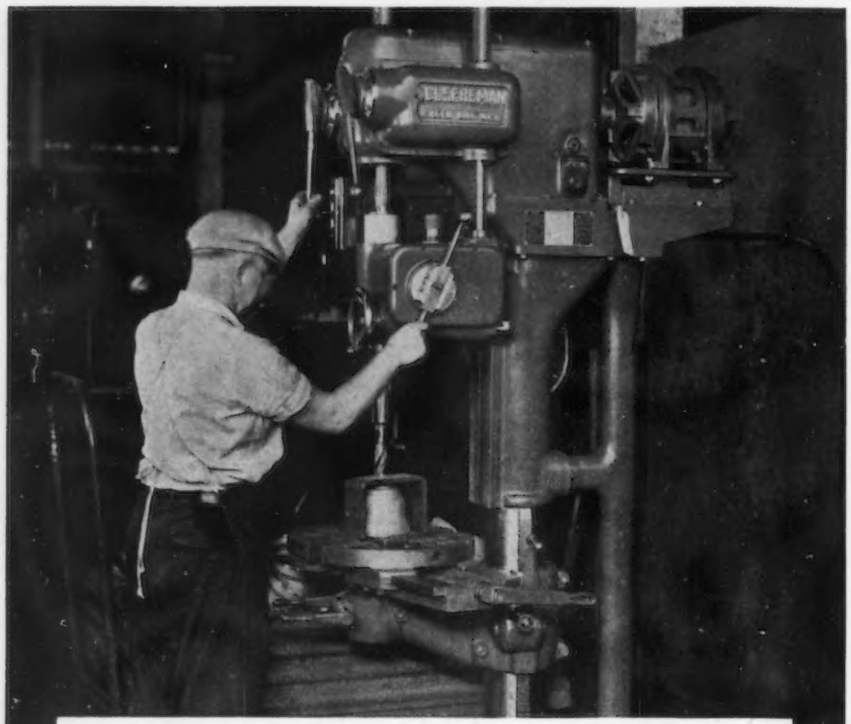
of this kind to do more than indicate general principles deduced from these researches. Practical operating formulas would have to be supplemented by volumes of tabular data. Such data is soon to be released in the form of a "Manual on Cutting of Metals," prepared by another sub-committee of the Special A.S.M.E. Research Committee on the Cutting of Metals.

The Influence of Graphite

Further tests were made with cutting fluids to which graphite emulsions or colloidal graphite in mineral oil has been added in small amounts. The former type of fluids have little commercial value since they are too messy as far as machine and operator are concerned.

The addition of colloidal graphite to plain mineral oil darkens the color of the oil, but it did not prove to be objectionable as the oil ran off and left the lathe and work clean. Maximum benefits in cutting speed or tool life are obtained when the per cent of colloidal graphite by weight in the mineral oil is 0.153. For a given tool life, an increase in cutting speed under these conditions averages 20 per cent. For a given cutting speed, the tool life increases 400 to 600 per cent. In Fig. 7 are shown comparative tool life curves with various cutting fluids, when turning SAE 3140 steel, depth of cut 0.10 in., feed 0.0125 in. The mineral oil with graphite is definitely superior, a soluble oil of 1:16 is next in line, water with 1½ per cent borax follows, then sulphurized mineral oil. The lowest curve is obtained cutting dry, as would be expected.

So much for theory. The results of a survey published by *Automotive Industries* in May 2, 1931, show that at that time there was wide variation in usage of cutting fluids, but the majority of companies reporting indicated they were using soluble oils in cutting steel. Sulphurized mineral oil was being used on automatic screw machines cutting steel almost as often as mineral-lard oil. The cost of lard oil is causing mineral-lard oils to be replaced by sulphurized oils on such jobs. The chief things that the tests referred to above showed were that for extremely short tool lives, the solu-



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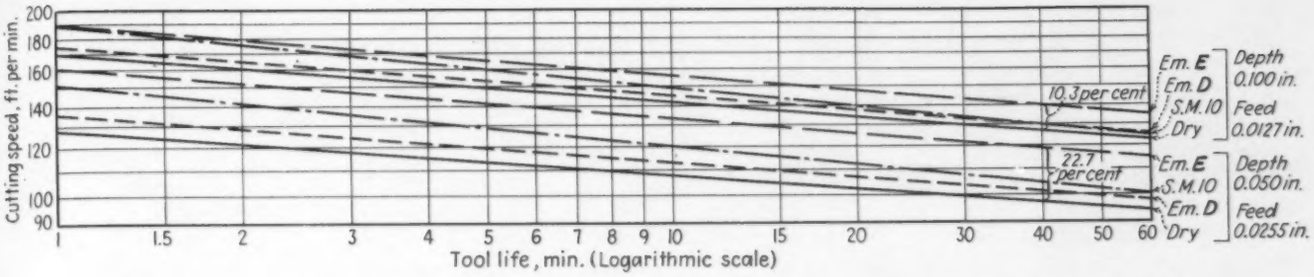

FIG. 8—Summary of cutting speed-tool life curves when turning monel metal with various cutting fluids. The sulphurized mineral oil, No. 10, definitely superior at low tool lives, is edged out by the soluble oil emulsions above 60 min. tool life.

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ble oil is superior to the sulphurized mineral oils, but for lives expected in commercial practice, the reverse is true. Reference to Fig. 7 bears this statement out.

Further tool life studies as related to cutting fluids when turning monel metal were carried on by Professor Boston and W. W. Gilbert in 1936.[7] These experiments confirmed earlier data that a deep, thin chip allows a higher cutting speed for a given tool life and equal chip area. With an emulsion and with a sulphurized mineral oil, for example, speeds 28 and 25 per cent higher, respectively, were obtained for the same tool life when using the deep, thin cut as compared to those for the shallow, thick cuts under the same conditions. The relationship between cutting speed and the depth of cut for a given tool life may be stated as:

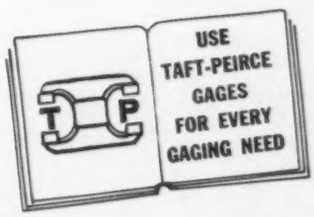
$$V d^{0.196} = K$$

where K is a constant and equal to 78.6 when cutting life is 60 min., f = 0.0127 in. per rev., and d = depth of cut in inches. By substituting the proper values in this formula, it is seen that by increasing the depth of cut from 0.025 to 0.05 in. or 100 per cent (the feed remaining constant), the cutting speed is reduced only 14 per cent for the same tool life.

The curves plotted from these test data in Fig. 8 also show that for the deep, thin cut emulsions E (transparent) and F (milky, soap-base soluble oil) of 1:15 mix were both definitely superior to a sulphurized mineral oil, S.M. 10.

The above mentioned test results were based on the use of a high speed steel tool of 22-deg. side rake and 3/64-in. nose radius. Comparative tests versus a tool with a 15-deg. side

[7] Progress Report No. 7. "A study of Cutting Fluids Applied to the Turning of Monel Metal," by O. W. Boston and W. W. Gilbert; presented to the A.S.M.E. in December, 1936, at New York.



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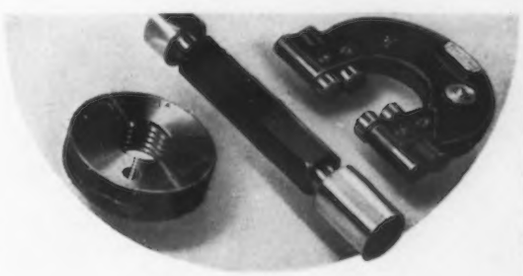

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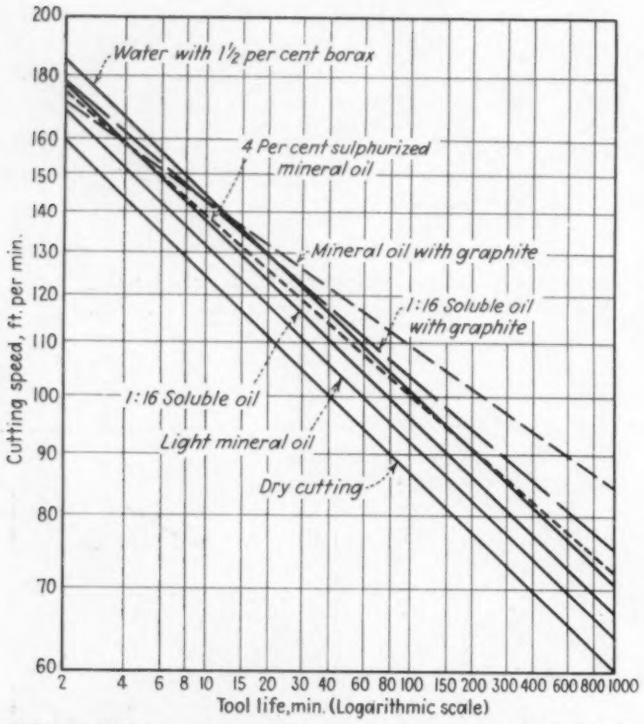
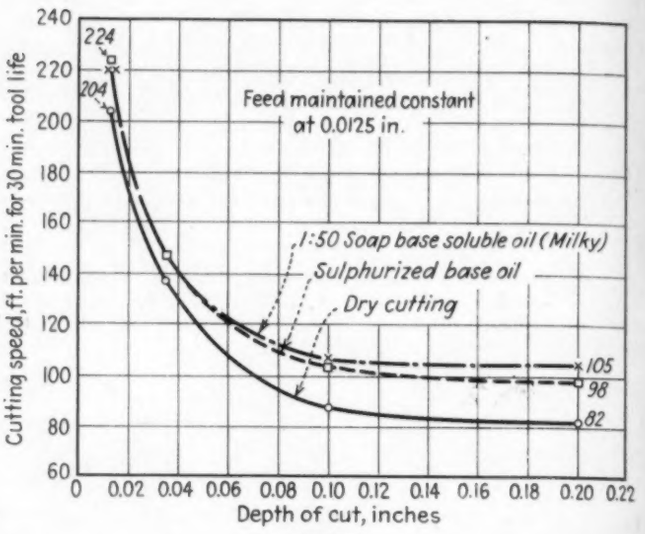

Water with 1½ per cent borax
4 Per cent sulphurized mineral oil
Mineral oil with graphite
1:16 Soluble oil with graphite
1:16 Soluble oil
Light mineral oil
Dry cutting
Cutting speed, ft. per min.
Tool life, min. (Logarithmic scale)

FIG. 7—Cutting speed-tool life curves for various types of cutting fluids, two with graphite additions, plotted on modified log-log coordinates. Material cut is normalized and annealed SAE 3140 steel, and tool is an 18-4-1 high speed steel ground to the standard shape, Fig. 5. The graphite addition of 0.0125 lb. per gal. was made to the soluble oil by adding colloidal graphite suspended in oil to the soluble oil before emulsification or directly to the straight mineral oil.



ABOVE

FIG. 10—Test data plotted on Cartesian (arithmetic) coordinates, showing the effect of varying the depth of cut for a constant feed of 0.0125 in. when cutting annealed SAE 3140 steel with the standard high speed steel tool bit (Fig. 5).

rake and ⅛-in. radius when cutting dry show the latter to be superior as regards speed-life relationships, but no tests were made with cutting fluids. Typical tool failure was cupping on the face and abrasion on the flank below the cutting edge.

Incidentally, the machined finish did not seem to be influenced by the type of cutting oil used. The chips are broken up better when the sulphurized mineral oil was used, although this oil stained the metal, but it was evident that an emulsion was entirely satisfactory as a cutting fluid for turning monel metal, particularly the richer mixtures.

Unpublished data made available to the author through the courtesy of Professor Boston as a result of further work of the A.S.M.E. Sub-Committee,[8] carried on with the aid of funds provided by the Engineering Foundation, check closely with many of the conclusions reached thus far and add other new conceptions as a result of extending the scope of the tests. This time the influence of cutting fluids and the size and shape of cut was observed when turning SAE 3140 steel, forged, normalized and annealed. The tool used was a high speed steel bit of the 18-4-1 variety ground to a 22-deg. side rake and 3/64th in. nose, Fig. 5, making this particular factor fixed, as regards comparison with earlier tests.

Once more it is definitely shown that for equal area of cut, the deep-thin chip gives much higher permissible speeds for a given tool life, no matter what cutting fluid is employed. Stated in another way, the speed-life curve (VT^n-C) when plotted on log-log paper is highest for the highest ratio of depth to feed (8:1, with constant area, other factors being equal). Under these conditions and

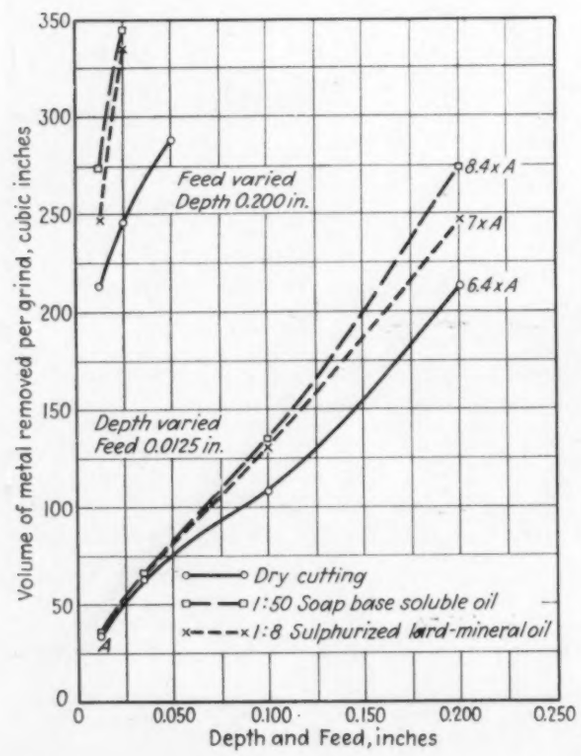

Feed varied Depth 0.200 in.
Depth varied Feed 0.0125 in.
8.4 x A
7 x A
6.4 x A
Dry cutting
1:50 Soap base soluble oil
1:8 Sulphurized lard-mineral oil
Volume of metal removed per grind, cubic inches
Depth and Feed, inches

FIG. 11—Metal removed per grind for a tool life of 100 min. with constant depth (upper left) and with constant feed (lower right). More efficient hogging cuts can be made with a thin emulsion, these curves indicate, than with a sulphurized lard-mineral oil.

[8] Present membership of the A.S.M.E. Sub-Committee on Cutting Fluids consists of O. W. Boston, chairman, Joseph Geschelin, *Automotive Industries*; William Oldacre, D. A. Stuart Co., and Frank Hoagland, Pratt & Whitney. Professor Boston participated in preparing report 2 and has conducted the research in preparation of report 3 to 7 alone.

for extremely short tool lives (1 to 30 min.) a sulphurized base oil gives the best performance but for tool lives in the range of commercial practice, a thin emulsion (1:50) is best; in fact even better than a more concentrated emulsion (1:15), under any ratio of depth of cut to feed for equal area of cut. Fig. 9 shows these relationships by plotting tool life curves on log-log paper.

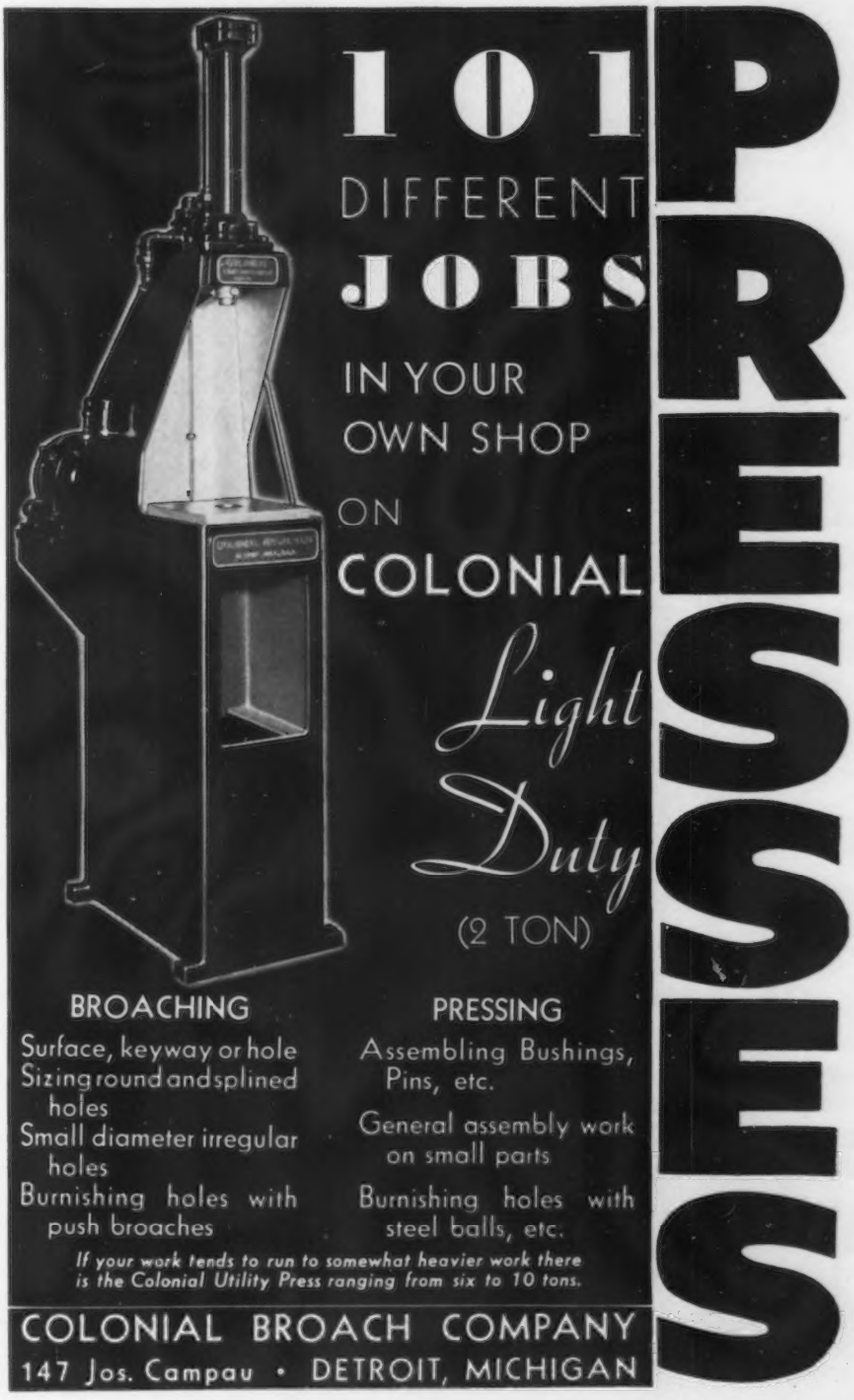
On the other hand, for variable depth of cut at *constant feed,* (0.0125 in.) the cutting speed-tool life line is obviously higher for the lightest cut (Fig. 10). Once again, however, the sulphurized base oils proved superior for short tool lives, but above 40 min., for a light depth of cut (0.035 in.), and above 1.75 min. for a heavy cut (0.200 in.), the thin emulsion showed up to better advantage. When a light depth of cut was employed, relatively little advantage could be shown with either cutting fluid over cutting dry, about 10 per cent at the most. But when the heaviest cut of 0.200 in. was made, for a 100-min. tool life, the gain in cutting speed is substantial, being 27.5 per cent for the 1:50 emulsion and 16.2 per cent for the sulphurized lard-mineral oil (one part of high sulphur base lard-oil blended with eight parts of a light mineral oil), the comparison being made against cutting dry. These relationships are shown in Fig. 10. If we compare the cubic inches of metal removed between grinds for the same 100-min. tool life, Fig. 11, the gain is somewhat higher but the relative standing of the two cutting fluids is maintained.

Maximum efficiency on hogging cuts is indicated further by a series of tests conducted with a constant depth of cut of 0.200 in. and variable feed. With the thin emulsion, a 40 per cent gain in relative metal removal for 100-min. tool life is recorded over dry cutting, for a feed of 0.025 in., whereas the gain for the sulphurized lard-mineral oil is 36 per cent, a difference that may not mean much commercially. The respective gain in cutting speed is about the same. The figures for the emulsion are a cutting speed of 57.5 ft. per min. and 345 cu. in. of metal removed per grind for 100 min. tool life.

While the cutting fluid produces a definite increase in cutting speed over dry cutting up to 40 per cent, corresponding to an increase of 1100 per cent in tool life for equal cutting speed, as has been indicated, these same tests showed that greater advantage may be obtained through the variation of the size and shape of cut.

What does all this research add up to? To summarize, we have noted that this A.S.M.E. research group started out with experiments designed to show the influence of various cutting fluids on the torque and thrust of drills and the force on a planer tool, then the influence on the time required to saw materials in a power hacksaw. It was not until the sixth report of the Sub-Committee was presented in 1935, almost seven years after the first report was filed, that a definite change in tack was made, and the relationship of cutting speeds to tool life with various cutting fluids was established as the dominating influence. Apparently, the committee felt that in practical shop application, time between grinds was much more important than power consumed by the tool and machine. This viewpoint has been preserved ever since.

It is generally understood that at low speeds and light cuts, cutting fluids improve the smoothness of the machined surface, but no attempt has been made to measure the exact effect



thus far, although the influence of the cutting fluid on the breaking up of the chip is commented upon in passing.

From the point of view of least power consumed in drilling, the sulphurized mineral oils, whether straight or blended, proved to be most advantageous when drilling various steels. Sulphurized oils, it may be remembered gave the best results from the wear point of view on the performance of tungsten steel hacksaw blades. But a lean emulsion of soluble oil gave a better performance than a straight mineral oil. The underlying effect of sulphur in the oil, ordinarily in amounts up to 3 to 4 per cent, was an unsolved problem to the committee then, and its true influence has yet to be found.

Graphite is another colloidal element that was found to greatly increase tool life, and in the particular tests performed on turning of SAE 3140 steel was found to be a more potent factor than the addition of flowers of sulphur to a mineral oil (Fig. 7). Graphite suspended in oil and added to a soluble oil also gave a better speed-life performance than the latter.

It was in the test data presented before the A.S.M.E. Semi-Annual meeting in 1935, however, that the cutting speed-tool life conception was first presented and here for the first time the cooling effect of the cutting fluid became noticeable, though the committee report made by Professor Boston did not comment upon this aspect at the time. The cutting speed-tool life curves shown in Fig. 6 indicate that for a given tool life, plain water is the fluid that permits the highest cutting speed. Later tests on monel metal (Fig. 8) indicated that an emul-

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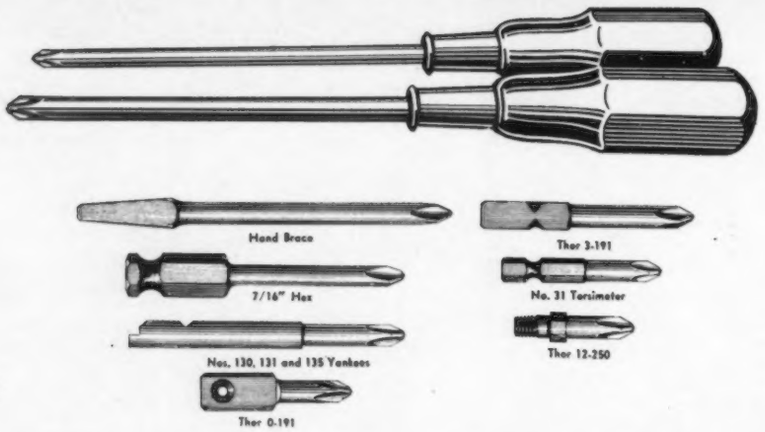

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Fundamentals of

(CONTINUED FROM PAGE 66)

Lubrication

It need hardly be stressed to anyone who has been concerned with the drawing of wire that efficient lubrication is a matter of really first-rate importance. The ill effects of inadequate lubrication are two-fold. In the first place, power is needlessly wasted in overcoming the excessive friction, thereby causing overheating of steel dies, while in the second, friction, by interfering with the regular flow of the metal, may lead to the production of wire of unsatisfactory quality. As an example of the influence of friction on the rise of temperature of the wire during drawing, mention may be made of a few measurements of the actual rise of temperature in a steel die where the wire-die interface was used as a

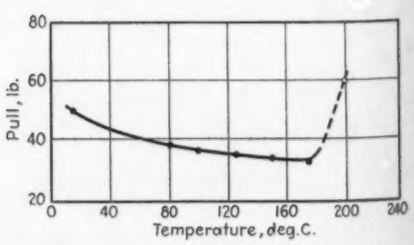

FIG. 16—It is apparent that the temperature of drawing must not go so high as to effect a chemical decomposition of the lubricant.

sion was entirely satisfactory as a cutting fluid. Still later and hitherto unpublished data (Figs. 9, 10 and 11) again show that a thin emulsion gives the best life performance for tools cutting SAE 3140 steel. Granted that 50 parts of the emulsion is water and one part soluble oil, it is apparent that the cooling effect predominates. Professor Boston raises the question then as to whether the small amount of oil present can technically be called a lubricant or whether it also is not primarily a coolant. The answer to this last conundrum might mean the difference of 4c. a gal. Federal tax on lubricating oils. It might be shown that "lubricants" used to make emulsions that are primarily coolants are not truly lubricants. Who knows?

Wire Drawing

thermocouple. Even at as slow a rate of drawing as 20 ft. per min., the rise of temperature when a dead-soft steel wire was reduced 20 per cent was about 85 deg. C. for an unlubricated die. When a good soap was employed as lubricant this fell to 40 deg. C. As the speed of drawing is raised the temperature rises still further, with the result that at commercial rates of drawing the difference of temperature between a well lubricated die and one which is ill-lubricated must be very high.

It should be pointed out, however, that where carbide dies are employed there is little or no evidence that the higher temperature resulting from this frictional heating has *per se* any harmful effect. Since these dies are utilised for the drawing of tungsten wire at a temperature of 700 deg. C., it is difficult to believe that the much lower temperatures reached during the drawing of steel wire, even under conditions of inferior lubrication can have much direct effect. It cannot be stressed too strongly, however, that sudden changes of temperature, by setting up thermal stresses in the relatively brittle material of the die, may lead to cracking. As will be shown later, the experimental evidence so far as it goes affords little or no justification for the trouble spent in water cooling these dies except from the point of view of limiting these rapid temperature fluctuations, and the same effect could probably be obtained just as effectively if the dies were heated,

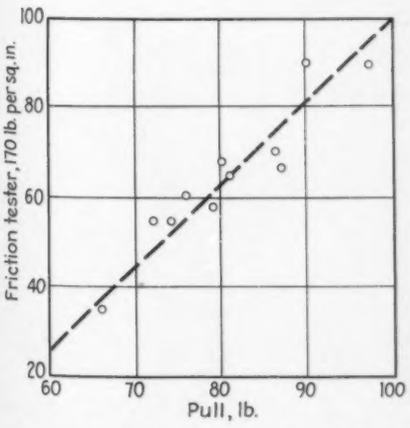

FIG. 17—Tensions necessary to draw down a mild steel 20 per cent with different lubricants. Note the proportionality between the two sets of lubricants.

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when the attendant advantages of moderately elevated temperatures on the lubricant would be obtained concomitantly. The writer has formed the opinion, for what it is worth, that the cooling of carbide dies is at times a fetish which is unduly pressed. Uniformity of temperature rather than a low temperature seems to him to be the ideal to be aimed at.

It is clear, however, that the temperature of drawing must not be allowed to attain such a figure that the lubricant commences to undergo chemical decomposition. Fig. 16, which represents measurements made with a soap lubricant on a mild steel wire, shows very clearly that, although up to a temperature of about 170 deg. C. the pull required to draw the wire falls progressively and is at that temperature some 34 per cent less than at 15 deg. C., there then sets in, due to the breakdown of the lubricant, a very rapid increase which is accompanied by rough and erratic drawing.

With one exception the effect of increasing the temperature to 160 deg. C. has invariably resulted in a diminution of the power required to effect a given reduction, a statement which is equally true of all of the solid and the liquid lubricants which have been examined. Since in certain cases the change of elastic limit is negligible, it follows that the economy is due, in essence at any rate, to a reduction of the frictional loss. A further result of this work has been to show that the differences between good and poor lubricants diminishes as the drawing temperature is raised. An extreme example of this fact is provided by water itself. Using as a comparison material a first-rate drawing soap, the difference at room temperatures in the pull needed was of the order of 35 per cent. At 98 deg. C. this had fallen to under 5 per cent. Water appears, therefore, just below its boiling point to be nearly as good as the soap. This may well be due to traces of grease on the wire since chemically pure water is a very poor lubricant on chemically clean surfaces. It would appear, however, to be an excellent lubricant for certain classes of wire, notably those which are to be subsequently tinned or enameled as a result of the clean, polished surface obtained.

An efficient soap lubricant leaves, as is well known, a thin film of that material on the surface of the wire. With less efficient lubrication this film gradually disappears and as a result the dull surface is progressively replaced by one which is brighter. For really bright surfaces it is suggested that poor lubrication, i.e. burnishing of the wire against the die, is essential.

Of the very many solid lubricants which the author has investigated the two best for steel wire have been a well-dried pure olive-oil soap, and one (No. 3535) produced from a mixture of tallow and palm-kernel oil. The analyses of these are given in the accompanying table.

ANALYSES OF THE TWO BEST SOLID DRAWING LUBRICANTS

	No. 3535, Per Cent	Dried Olive-Oil Soap, Per Cent
Total fatty acids.....	82.53	84.46
Free fat	0.66	0.11
Combined fat	81.87	84.35
Free caustic alkali...	Nil	Nil
Combined alkali	9.80	9.10
Glycerine	1.70	0.20
Water (by difference)	5.97	6.24
M.P. of fatty acids...	36.4*	24.4*

*Deg. C.

A class of soaps concerning which comparatively little is generally known so far as their lubricating properties are concerned are those in which the

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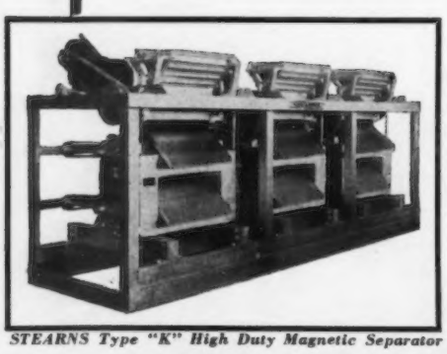

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metallic radical is other than sodium or potassium. We have had most excellent results from barium oleate, which is the very best lubricant for steel of the scores—one might say almost hundreds—which the author has tried. There is a very fruitful field for further research in this direction.

While considering the soap No. 3535, it must be pointed out that good as this material is as a lubricant, it suffers from one most serious disadvantage, in that it may cause wire-drawer's dermatitis. So far as can

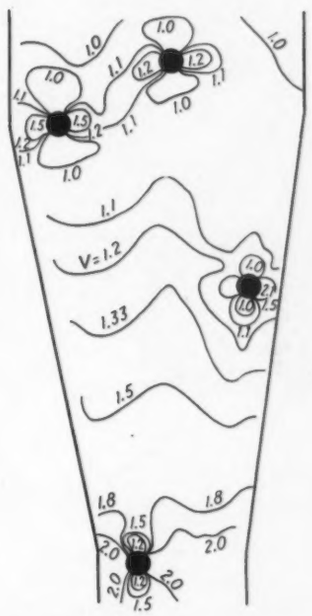


FIG. 18—Lines of equal velocity of flow arising from inclusions in the original wire rod.

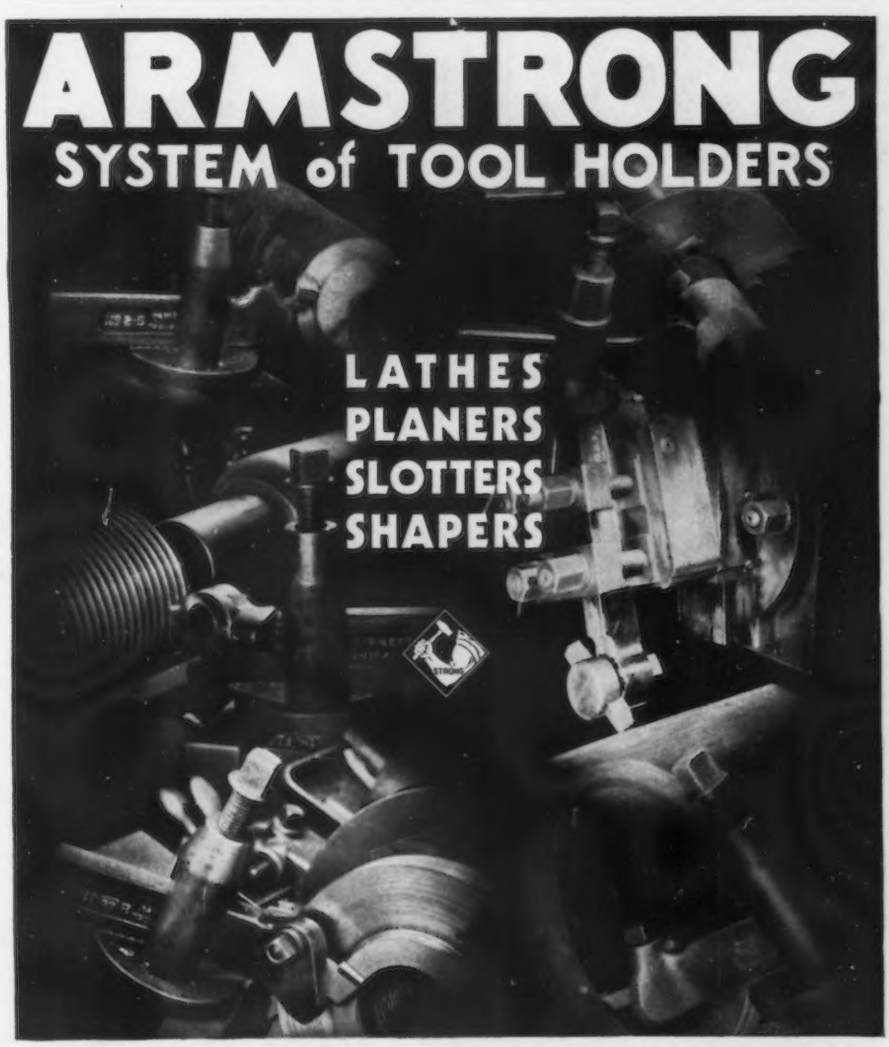
be learned, the facts concerning this disease are as follows:

Soap is the only form of lubricant used in drawing wire which apparently results in this trouble. Further, the lime coat plays a part, as is shown by the fact that in one establishment where this disease was repeatedly experienced it was not in the soap store where large quantities of the soap were handled that it occurred, but that the sufferers were the men actually drawing the wire. One point on which all seem agreed is that certain persons are particularly susceptible, and that these, in general, are men whose hands are moist. That the sweat does play an important part is proved in several directions.

Regarding the relationship of the disease and any special constituent of the soap there is a wide difference of opinion, but the following points appear to be substantiated. This form of dermatitis has never been known to follow the use of a pure olive-oil soap, nor would one produced from arachis oil be expected to lead to the complaint. On the other hand, there are grounds for the belief that soaps made from fat charges including a large proportion of cocoanut or palm-kernel oil, reacting on the skins of those possessing an idiosyncrasy to this complaint, lead to the disease. Factors which may also be operative include the undue scrubbing of the hands with hard brushes after work, and the effects of grit, etc., which would be expected to be highly injurious. If, prior to work, the hands are well rubbed with a mixture of unsalted lard and 5 per cent boric acid the trouble can generally be eliminated.

The desirability of having some rapid test for assessing the value of a wire-drawing lubricant, led us to examine the possibility of applying some form of friction-tester to this prob-

(CONTINUED ON PAGE 289)



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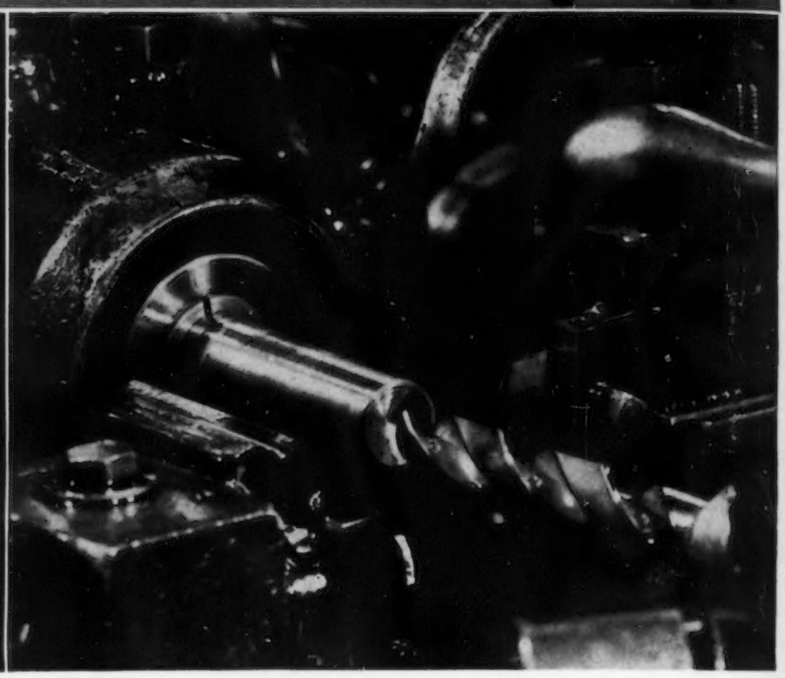

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Average holes per drill per grind	300	25
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Per drill $25.56

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ALLOYS containing silver, called "silver solders," have long been used for metal joining. Usually the applications have been only where nothing else would be suitable. In the manufacture of silverware and jewelry, the use of silver solders was absolutely required but, for industrial uses, there were only a few highly specialized places where the alloys would be considered, as nothing else met the production or service requirements.

The joining of band saws, or for some special electrical connection, or on small parts where high strength was necessary were the extent of the industrial uses. For applications of this type, silver solders were frequently purchased in hardware stores. The quantities used were small and the prices were exceedingly high as these silver solders had relatively high silver content. The lowest melting point solder available had a melting point of 1325 deg. F., but had a silver content of 60 per cent.

Research work in recent years has developed new silver alloys with lower melting points which incorporate the brazing characteristics of silver solders in compositions containing less silver—in some cases as little as 10 per cent. These developments have broadened the field of application, and low temperature silver brazing alloys are now used extensively for all types of metal joining.

One of the alloys developed, known as Sil-Fos Brazing Alloy, is composed of 15 per cent silver, 80 per cent copper and 5 per cent phosphorus. It is used for joining non-ferrous metals, principally copper, brass and bronze. This silver brazing alloy has a melting point of 1185 deg. F. and is free-flowing at 1300 deg. F. This low working temperature and the free-flowing and penetrating qualities of the alloy are the chief reasons for its widespread use.

Another alloy, known as Easy-Flo Brazing Alloy, begins to melt at 1160 deg. F. and is unusually free-flowing at the extremely low temperature of 1175 deg. F., has a medium silver content of about 50 per cent, and the balance of about equal portions of copper, zinc and cadmium. Of all the alloys available, Easy-Flo probably has the lowest melting point and certainly has most unusual properties. It is used for joining practically all ferrous and non-ferrous metals, either together or in combinations.

With the development of low temperature silver brazing alloys, the type

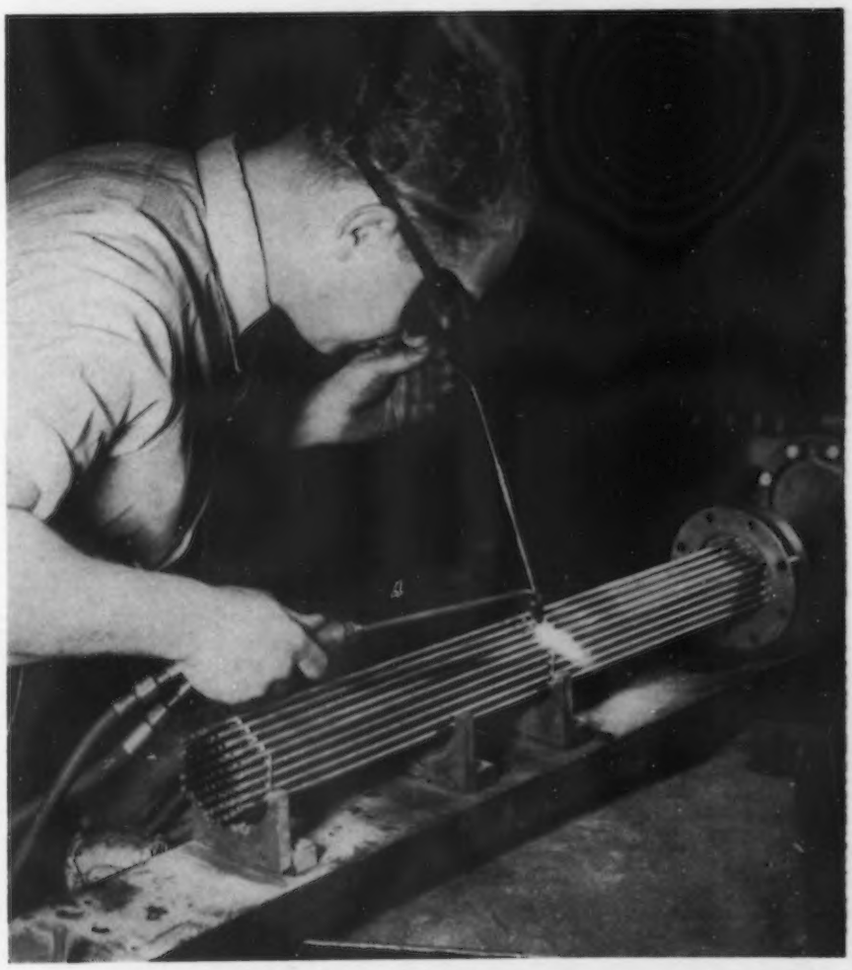


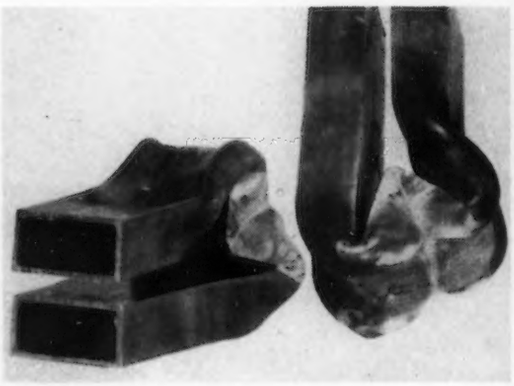
FIG. 2—Brazing 31 tubes into one of six condenser units on a 20-ton industrial refrigerating unit with silver brazing alloys.

of flux to use became most important. When brazing, the flux acts as a protection against oxidation, dissolves oxides which may form during heating and assists in the free-flowing of the brazing alloy. It is evident, therefore, that a good flux should be liquid at soldering temperatures and have a minimum tendency to volatilize at these temperatures. Fluxes then known did not meet the requirements, and the advantages of the low melting point alloys were lost if the flux used was not active until 1400 deg. F. or higher.

o o o

FIG. 1—Extruded brass section brazed at the mitre, then bent back on itself, cold, through a 270-deg. arc. The joint shows no failure.

o o o



Ordinary borax and boric acid fluxes, regularly used, were in this group and were not active or effective at the low melting temperatures of these alloys.

To meet these requirements, research development again came to the fore, producing low temperature brazing fluxes, permitting taking full advantage of the low temperature silver brazing alloys.

A low temperature brazing flux, known as Handy Flux, begins to fuse at 800 deg. F., and at 1100 deg. F. is a thin, active fluid which insures thorough wetting of joint surfaces by these silver brazing alloys. The combined use of the low temperature brazing flux with the low temperature brazing alloys has produced an excellent joining medium. The low working temperatures make them particularly desirable for joining copper, brass, bronze, Monel and other non-ferrous alloys that can be heated to 1175 deg. F., and for joining ferrous metals, including stainless steel, Carboloy, etc. They are widely used for the joining of dissimilar metals, for example the joining of copper to stainless steel.

Low temperature silver brazing alloys are not usually associated with high strength joints by one not familiar with their use. Tensile strengths of 40,000 to 60,000 lb. per sq. in. or higher, depending upon the metals joined, are regularly produced. Laboratory tests on butt joints made with stainless steel have indicated strength as high as 134,000 lb. per sq. in. In most cases, particularly with non-ferrous metals, the joints are stronger than the metals joined. Fig. 1 illustrates a silver brazed joint after a persuasion test to determine whether the joint could take it.

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Assembly men work faster, make fewer mistakes, with Dyno-Mite Drills, Nut Runners, and Screw Drivers—the world's finest and smallest production units. Dyno-Mite tools are streamlined, compact, unique, easily operated with *one hand* in out-of-the-way corners. *No other tool* handles with such perfect control, such freedom from fatigue. Ask your distributor to arrange a free trial in your own plant.

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DYNO-MITE SCREW DRIVER AND NUT RUNNER

Same power unit as Dyno-Mite Drill PLUS one all-important feature, the ADJUSTOMATIC CLUTCH: *accurate* torque setting by a simple turn of the indexed collar *outside* the housing—releasing a vibrationless, constant flow of controlled power.

MILLERS FALLS TOOLS SINCE 1868

MILLERS FALLS COMPANY GREENFIELD MASSACHUSETTS

under his standard production schedule. Joints are usually designed for close fits, only a few thousandths of an inch is best. Thus it can be seen how little brazing alloy is necessary when the metal surfaces are cleaned and fluxed and properly heated. The silver brazing alloy is pulled quickly into and through the joints by capillary action, alloying with the metals and joining at temperatures below the melting point of the metals. The result is an almost indestructible bond at a temperature low enough to prevent damaging the metal structure.

o o o

FIG. 3—Assembling unit heaters. Thin copper tubing silver brazed to bronze header for high strength joints at high temperature.

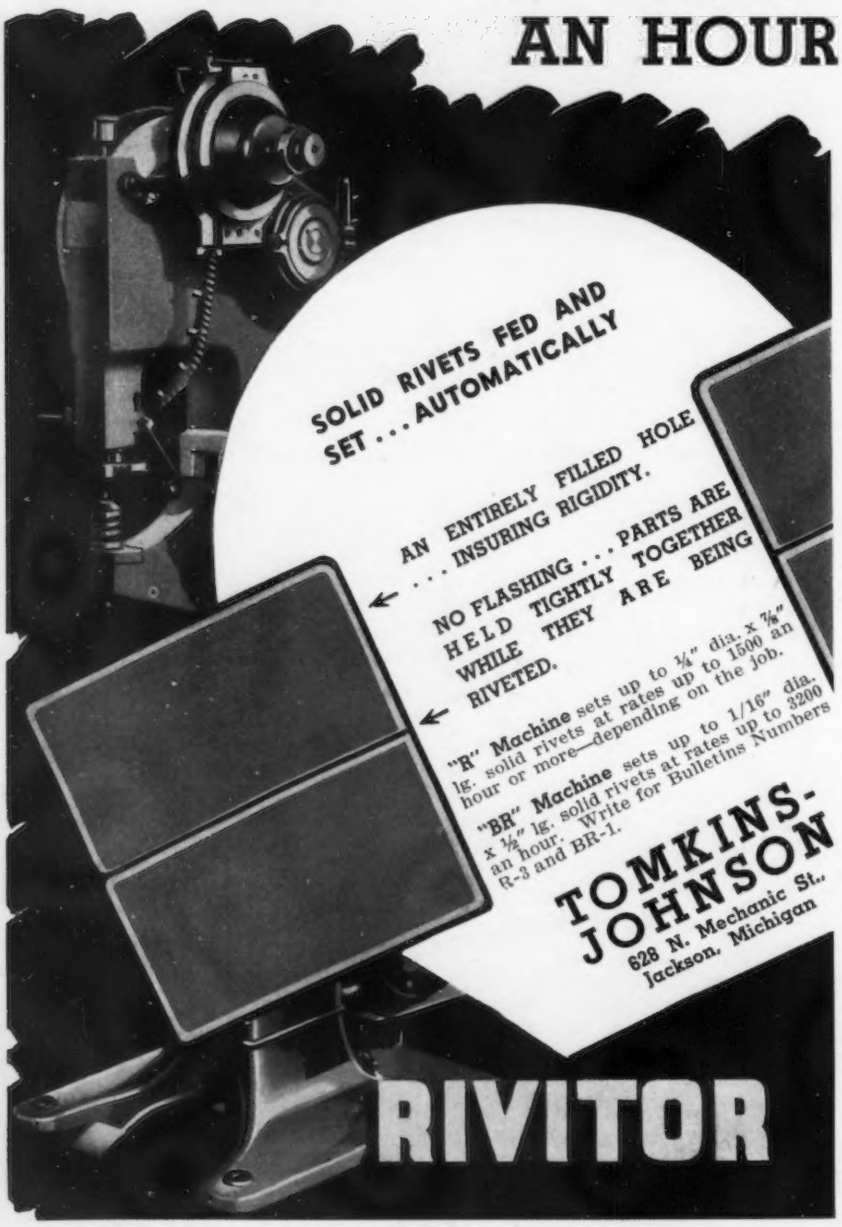
o o o

As the remarkable working properties of these silver brazing alloys are becoming better known, manufacturers have been steadily increasing their uses for the many metal joining problems which confront practically all industrial users of metals.

In the air conditioning, refrigeration and piping fields, silver brazing alloys have found wide application. Strong, leak-proof and gas-tight joints are required for piping lines, tanks and equipment carrying gases and liquids under fairly high pressures. Therefore, it is essential that these industries use joining mediums which produce joints that are not porous—joints that gases cannot seep through. The extremes of heat and cold, heavy shock and vibration do not loosen these silver brazed joints; the silver content prevents brittleness and precludes disintegration.

In the refrigeration field, particularly where equipment is made in great quantities, in a manner similar to the production lines of the automobile industry, ease of application and reliability at low cost are important, even more important is the expense caused by rejects in production and the ill-will of their customers as a result of breakdowns. Fig. 2 illustrates an operator brazing condensers for an industrial refrigerating unit. This is a common practice in this industry and this particular operation consists of the joining of 31 hard copper tubes into a comparatively light copper tube sheet. Six condensing units are used in a

1500 TO 3200
STRONGER JOINTS
AN HOUR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AN ENTIRELY FILLED HOLE . . . INSURING RIGIDITY.
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"R" Machine sets up to ¼" dia. x ⅞" lg. solid rivets at rates up to 1500 an hour or more—depending on the job.
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o o o

FIG. 4 — Brazing pipe joints with silver brazing alloys. Note range of sizes.

o o o

qualities and ease of application of silver brazing alloys have become the specified practice. A well known manufacturer of pipe fittings has offered a line in which inserts of silver brazing alloy are placed in grooves in the fitting. Fittings for pipe sizes up to 12 in. are produced. Fig. 4 illustrates a typical installation. Tests by federal, military and civil engineering organizations have thoroughly demonstrated that the use of silver brazing alloys in pipe joints will produce such

20-ton machine making a total of 372 silver brazed joints in each machine. Between the water circuit and the refrigerant circuit there is a difference in pressure of approximately 150 lb. per sq. in. Naturally, leaks cannot be tolerated in equipment of this type and manufacturers report that when units of this type were developed, the proper bonding of this type of joint seemed almost an unsurmountable problem. The manufacturer whose unit is illustrated reports that this type of unit has been used in 10 of their regular models for over two years and they have yet to receive the first complaint from leakage. They likewise see no evidence of electrolytic or corrosive action on any of these joints and from laboratory experience do not anticipate any trouble of this nature.

The assembly of unit heaters illustrated in Fig. 3 is an application where, in addition to leakproof joints, high strength and ductility are essential. Thin copper tubing is brazed to heavy bronze headers in making these unit heaters and the assembly is simplified by the low working temperature necessary to flow silver brazing alloys into the joints. If higher temperatures were used, such as necessary for other welding processes, the distortion of the metal sections would not permit the use of a fusion joining medium.

Piping lines which carry gas, oil, water, compressed air, etc., is another field where the use of silver brazing alloys is becoming the accepted practice. Particularly on marine applications where installations and repairs are difficult to make the dependable

EJECTING COILS

(weighing up to 12,000 lbs.)

IS THE JOB OF THIS

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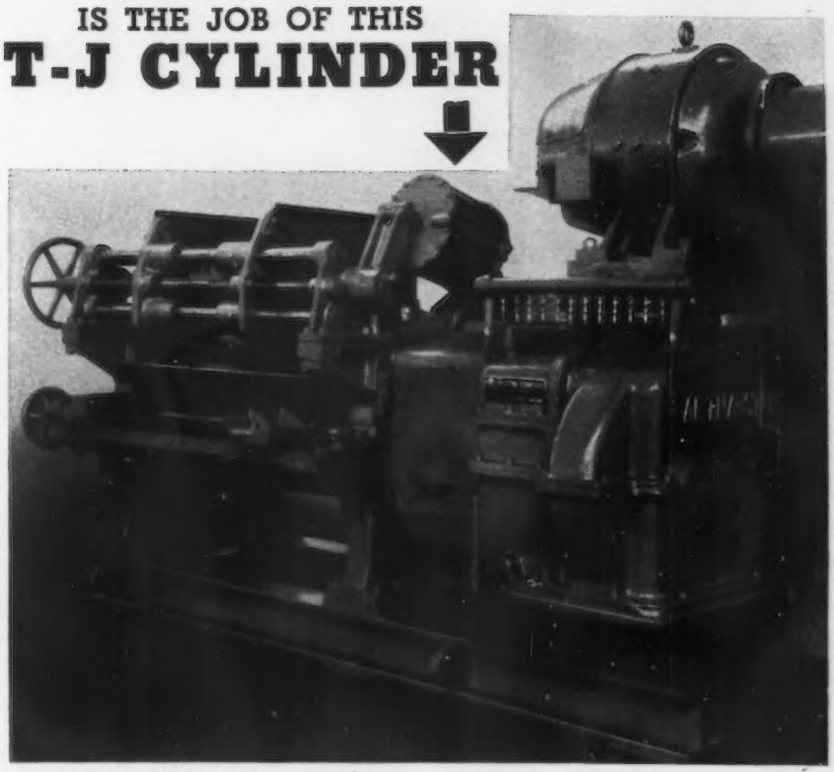

AETNA STANDARD ROLL TYPE COILER

As the strip is completely coiled it must be discharged from the carrier rolls to a conveyor. Kick-out fingers are provided which are operated by the air cylinder. The fingers raise the coil and push it forward where it then rolls onto the conveyor.

A Cylinder to handle this job (note that the cylinder motion rotates a shaft to which the fingers are keyed) must incorporate features which count for service. The type of service that you need on your machines. These "service" features control the design of T-J CYLINDERS. Write to us for your copy of our catalog No. 36 which gives specifications.

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Jackson, Michigan

high strength that the pipes or fittings will fail before the brazed joints.

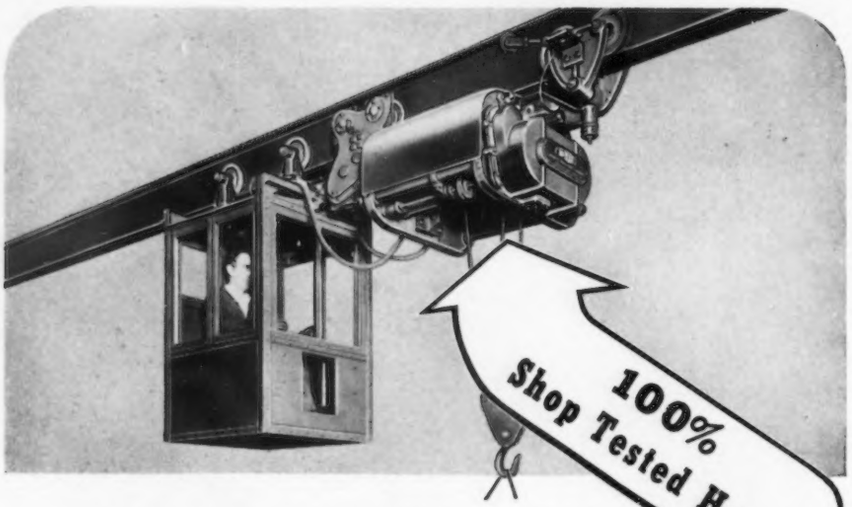
A recent development is an interesting example of the ready acceptance of silver brazing alloys as an ideal joining medium where stresses and strains are of such a nature that only the most ductile materials can be used for the joining medium. A water tube boiler was recently constructed containing 1238 copper tubes, each 35½ in. long, ¾ in. O.D., 0.049 in. wall thickness, joined to mild steel headers ¾ in. thick and 48 in. in diameter, by means of a silver brazing alloy with a flow point of 1175 deg. F. This boiler is giving satisfactory results in service and operates at 225 lb. pressure, and at steam temperatures of 396 deg. F. During the testing period it was run up to full working pressure, steam released and cold feed water forced in. Even with this severe test, which ordinarily would not be encountered, not one of the 2476 joints showed any ill effects.

The free-flowing properties of silver brazing alloys at low temperatures are most important in those fields where light metal parts are assembled. Similarly, those special alloys or dissimilar metals, detrimentally affected by average welding temperatures, can readily be joined. Fig. 5 shows an interesting application of a truck engine oil float. A brass tube is joined to the steel body and distortion of the metal surfaces is not permissible. High strength and ductility at an operating

o o o

FIG. 5—This oil float is brass joined to a steel body. Temperatures exceeding 300 deg. F. and constant road vibration do not affect the ductility or strength of this type of brazed joint.

o o o



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*Classified phone directories list the local A-E-CO representative in principal cities. Call him in . . . or write us for the new hoist catalog. Other A-E-CO Products: Taylor Stoker Units • Marine Deck Auxiliaries • Hele-Shaw Fluid Power.

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AMERICAN ENGINEERING COMPANY

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FIG. 6—The spout of this stainless steel tea kettle is brazed with a silver alloy. This job has a low finishing cost and good appearance, and is very strong.

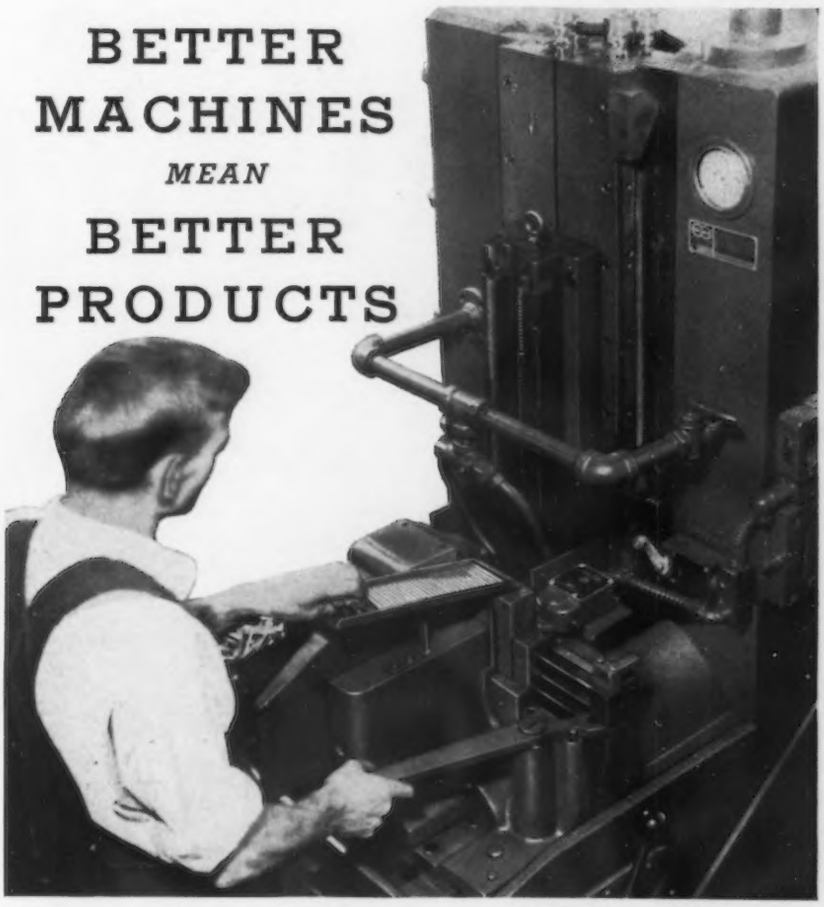
temperature of 300 deg. F. are essential. The stainless steel teakettle shown in Fig. 6 illustrates a neat, strong, low cost job. The spout has been brazed with low temperature silver brazing alloys with good appearance and low finishing costs. Fig. 7 illustrates photographic trays made of Inconel sheet. Joints with high strength as well as very good corrosion resistance are essential and the low working temperature of the silver brazing alloy eliminates assembling difficulties because of buckling and warpage of the plates.

Silver brazing alloys are being widely accepted for the furnace brazing of small parts. The operation is similar to that followed for copper brazing technique. When non-ferrous parts are to be brazed, naturally the high temperatures necessary for copper brazing cannot be used. It is in this field where the low melting points of silver brazing alloys are meeting a wide and varied demand. Similarly, on some ordinary steel and stainless steel parts where the temperature of 2100 deg. F. necessary for copper brazing causes destructive effects on the metal structures, the low melting point of 1175 deg. F. of the silver brazing alloy opens a wide field of uses. Fig. 8 shows a furnace brazing operation where brazed brass joints have replaced a one-piece pressure casting. The result is many times the strength of the previous construction, better appearance, lower production and finishing costs.

In the electrical industry, silver brazing alloys have found their widest application. From joining small 39 gage enamel coated wire for meters to joining copper bus bars ½ x 6 in. for a 36,000-amp. plating installation is a small indication of its wide field of use. These alloys have shown marked superiority over other joining mediums for assembling rotor bars in induction motors, for joining tap connections and internal windings of all types and sizes of transformers. One of the largest manufacturers of electrical equipment predicts that within two years silver brazing alloys will replace practically all mechanical or soft soldered joints which are now being used. All the features of these alloys which have been pointed out on other applications are required in the elec-

FIG. 7—Inconel photographic trays joined with silver brazing alloys for strength and resistance to corrosion.

BETTER MACHINES *MEAN* BETTER PRODUCTS



● The trend in American Industry is sharply toward giving better value—by cutting costs, improving parts or the whole, by smoothing and speeding the way to production.

Only constant alertness—sharpest scrutiny of production methods can give a producer a place in this marching parade.

Production men, of *all* men, should know the Oilgear Story . . . how a steady stream of improvements both major and minor keep Oilgear Presses, Broaches, etc. at the head in these important production-tool fields.

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BROACHING MACHINES AND PRESSES

trical field, plus high electrical conductivity.

Silver brazing alloys do not interfere with the electrical conductivity of most metals joined, the copper and silver constituents of the brazing alloy having high electrical conductivity and even butt joints on high conductivity copper will show very little increased resistance. The conductivity of silver brazing alloys is many times higher than the lead-tin solders. The amount of brazing alloy necessary to produce these strong, neat appearing joints is very small compared to the amount of material necessary when soft solders or base metals are used which require large fillets and built-up sections in order to obtain strength.

Fig. 9 illustrates a large copper bus bar installation capable of delivering 36,000 amp. at 4 to 5 volts. With such heavy current, joining of the bus bars was an all important problem and to avoid joint deterioration and resultant voltage drop, a combination soldered and bolted installation was specified. Brazed joints using silver brazing alloys were investigated and found to be 40 per cent cheaper and easier to make. The electrical conductivity was many times higher than the proposed method, and tensile tests on the joints gave a figure of 68,500 lb. per sq. in. This is only one example of such installations and the same procedure has been found to work equally successful on systems which operate on a higher voltage range at lower currents.

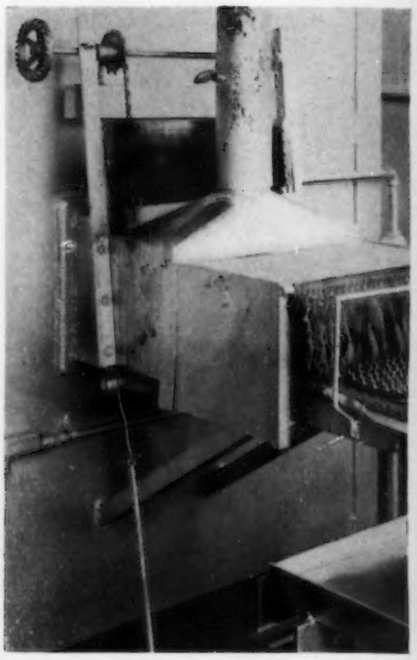

FIG. 8—Furnace brazed brass joints made pressure castings. The result is many times as good appearance, and having

LOW RUNNING COST
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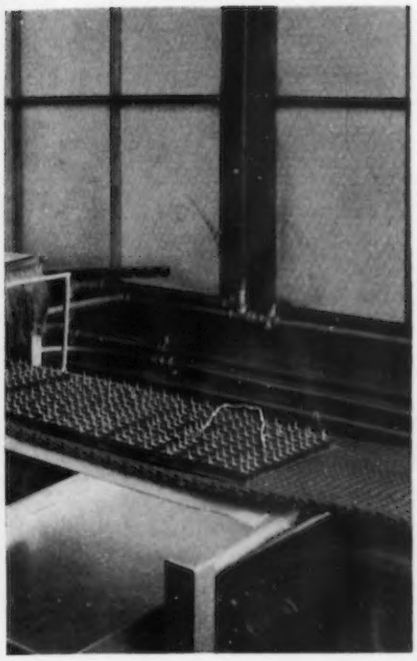
It's the "after" cost that determines real crane economy. Tiger cranes are economical because they operate so freely and easily over long periods of time with little or no wear, thus saving both power and maintenance expense. In metal-working plants everywhere Tiger cranes are chosen for best performance at least cost.

Write for Bulletin No. 300

WHITING CORPORATION
15601 Lathrop Avenue, Harvey, Illinois

WHITING
PIONEERS SINCE 1884

FIG. 9—Twenty tons of copper bus-bar replacing the combination soldered and



with silver brazing alloys replace one piece the strength of previous construction, just lower production and finishing costs.

Corrosion is usually a serious fáctor in metal joining. Silver brazing alloys will successfully resist many kinds of corrosion. When used to join copper, brass and bronze, the joints are as corrosion resistant as the metals themselves. Silver, which is known to be highly resistant to most corrosives, makes these silver brazing alloys good corrosion resistant joining mediums.

Ordinarily, very little silver brazing alloy is required regardless of the nature of the joint to be made. In fact, so little is generally required that the joint is usually inconspicuous. No massive sections of welding metal are built up outside the joint, the strength comes entirely from the alloy which flows into the joint. Consequently, the amount of brazing alloy used is very small. This reduces the cost of each joint to a surprisingly low figure. The experience of a tank manufacturer shows a good example. The mounting of tank flanges and spuds to which piping is connected is a troublesome job in tank and boiler construction. Formerly 50-50 soft solder had been specified on these joints and in most instances it was found necessary to use ½ lb. of soft solder to get a satisfactory joint. This manufacturer found that by changing over to silver brazing alloys his material cost alone was reduced 50 per cent per joint and a less expensive type of flange could be used.

Because of the low working temper-

(CONTINUED ON PAGE 290)

installation joined with silver brazing alloy, bolted installation originally specified.

GARLOCK 90—Coil
GARLOCK 92—Spiral
GARLOCK 99—Ring

GARLOCK 90

Waterproof Hydraulic Flax Packing

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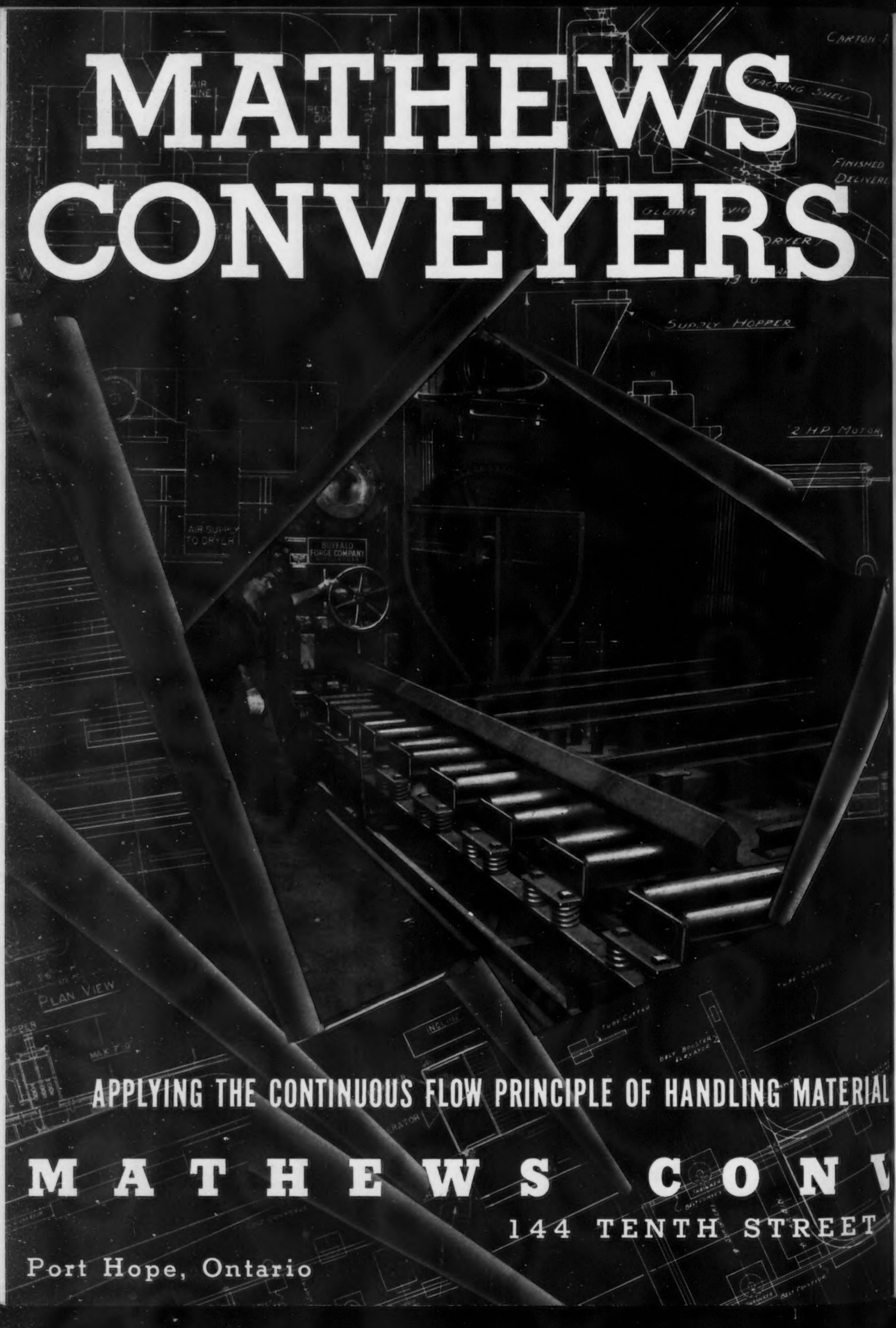

APPLYING THE CONTINUOUS FLOW PRINCIPLE OF HANDLING MATERIAL

M A T H E W S C O N V

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Port Hope, Ontario

8-inch, 7 ply Condor Compensated Belt operating on a Pulmax Drive in large paper mill. Belt is 32 ft. 10 in. long and has never been taken up or removed from pulleys in five years.

THE TOUGHER THE DRIVE . . . THE GREATER THE NEED FOR

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The Belt with Equalized Ply Stresses

In practically every plant, one or more drives are a constant source of trouble. Drives that usually wreck ordinary rubber belts . . . causing production delays and adding to operating and maintenance costs and troubles.

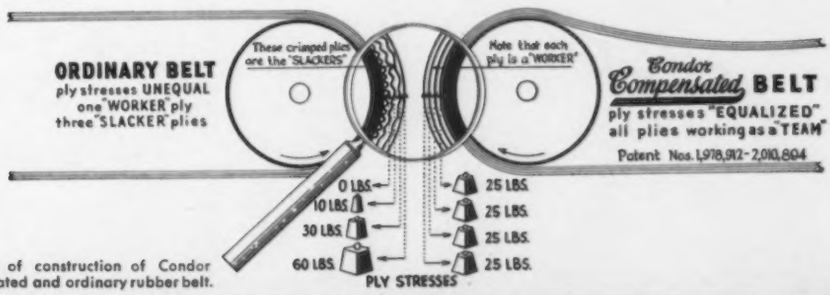
On these drives, Condor Compensated proves to be no ordinary belt . . . by transmitting efficient, economical power under the most grueling conditions.

Compare Condor Compensated's principle of construction with that of ordinary rubber belt in the diagram below. Notice that in Condor Compensated each ply bears its share of the load, as indicated by the weights, when the belt flexes around the pulley —where the destructive work is done. But, in ordinary rubber belt, the outside ply carries a greater burden—the "back-breaking" load, that ruptures and separates the plies and breaks fasteners—and inside plies buckle to shirk their load, to increase creep and wear, and result in premature breakdown.

This exclusive, patented Manhattan design has 12 advantages.* In addition, Condor Compensated has a special pulley side to permit low tension operation. In short, all this means higher production efficiency and lower production costs from any drive equipped with Condor Compensated. It is also available in Type F where rubber friction surface is desired, and in Type B where some slip is necessary.

*12 ADVANTAGES

1. Ruptures in outside ply eliminated
2. Freedom from ply separation
3. Longer fastener life
4. Can be operated on smaller pulleys
5. Less bearing, shafting and hanger troubles
6. For heavy loads, plies may be increased with same pulleys
7. Operation less affected by atmospheric conditions
8. Higher overload capacity or margin of safety
9. Less wear on pulley side
10. Can be dressed without injury to belt
11. High production efficiency
12. Material reduction in belting costs



Principle of construction of Condor Compensated and ordinary rubber belt.

THE MANHATTAN RUBBER MFG. DIVISION

OF RAYBESTOS-MANHATTAN, INC.

EXECUTIVE OFFICES AND FACTORIES, 32 TOWNSEND ST., PASSAIC, N. J.

Metal TREATMENT

FOR five thousand years the small was obsequious to the large, a situation reversed in part 100 years ago when metallurgists started fussing with the delicate nuances of alloys. Today, the potent influence of the apparently small on the obviously large is completely respected, a respect which has created the Age of Alloys, a respect which literally has changed the face of the whole world. Or, as the prescient poet Robert Browning said—

"Well, sir, the old way's altered somewhat since,
And the world wears another aspect now;
. . . . . .
The small becomes the dreadful and immense."

In steel, nature has enshrined a series of secrets most complex, secrets wrenched loose only in proportion to the knowledge of the interdependence between minute quantities of elements and the mass of parent metal. Without such knowledge steel is treacherous. With such knowledge, four tons of iron is confidently united with a spot of carbon, so-much chromium, a little of this, a little of that, then forged, and finally quenched in oil with the pyrotechnic display shown opposite, all with predictable toughness, hardness and strength in the final roll shell.

Controlled Heat Dissipation

By J. G. COUTANT

Refractory and Fuel Consultant, New York

TO control the rate of heat dissipation from metal charges in furnaces at first glance may seem an uninteresting subject; for the average heat engineer has long been chiefly concerned with the opposite phase of the problem, industrial heating. Rare indeed are data pertinent to industrial de-heating. But yet, this branch of fuel and refractory technology has contributed enviably to the problem of speeding locomotives over steel rails at 100 miles per hr. safely, to permit ship speeds of over 50 miles per hr., air speeds of 400 miles per hr., and to enable cannons to shell cities at a distance of 75 miles.

All these achievements, particularly the safety of rail transportation, may be credited to a sensible degree to those few engineers who have devel-

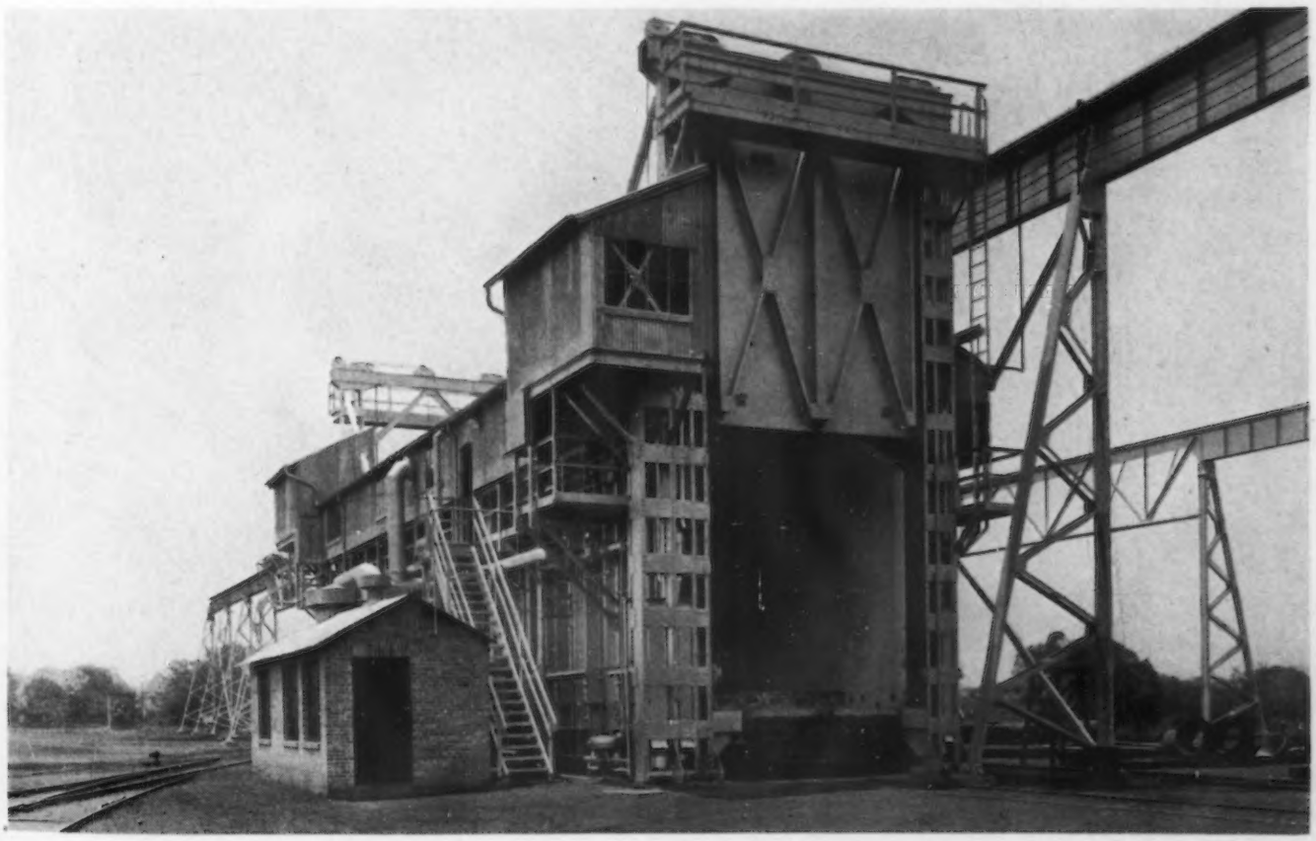


FIG. 1—One of the largest stress-relieving furnaces ever built, which has a maximum charge of 160 tons. It's a major refractory problem to secure temperature uniformity, particularly when the sun is shining on the roof and a wind is blowing against one corner.

oped light weight refractories capable of controlling the rate of heat dissipation. Still fewer men are particularly concerned with the calculation of the rate of de-heating of metal charges in stress relieving furnaces, and it is this latter problem which will be treated in some detail in the following paragraphs.

Stress relieving furnaces as large as an ordinary house are not uncommon, but the really dramatic phase of such equipment is the maintenance and control of uniform temperature throughout the whole tremendous volume. Stress relieving furnaces, such as the one shown in Fig. 1, are built as large as an ordinary house, and it is possible to maintain a uniform temperature control throughout the whole tremendous volume. The metal de-heating furnace in Fig. 1 was built by the Rust Furnace Co. for the Chicago Bridge & Iron Co. at Birmingham, Alabama. It is 80 ft. long, 14 ft. wide and 17 ft. high, is lined with lightweight firebrick, and has a 160-ton metal de-heating capacity. It would be impossible to maintain such control as is necessary, particularly when the furnace is outside and subject to varying winds, sunlight, etc., if the furnrace were not made of some lightweight low-heat storage refractory material.

Other examples of the value of such refractories may be found in the pit type of furnace for chilled car wheels, furnaces such as car, walking beam, direct and indirect fired semi-muffle or combustion chamber and radiant tube units, tunnel furnaces for rails and castings, etc.

The non-uniform heating and sudden irregular cooling of metals in various manufacturing processes often result in internal stresses, on occasion of sufficient magnitude to weaken or even rupture the product. The removal of the stresses, and in some cases a change in physical structure, are the primary functions of heat treating furnaces, the well-known theory being the control of the rate of cooling so that certain known molecular changes in structure may take place at different temperatures.

Some years ago annealing furnaces and stress relieving furnaces were constructed of heavy firebrick, the brick having high thermal conductivity and heat storage capacity which made accurate control of the rate of cooling very difficult. These same furnaces now are constructed of thin-wall insulating refractories having opposite characteristics, the result being that products treated in these new furnaces are of improved uniformity and have greater service life and a high safety factor.

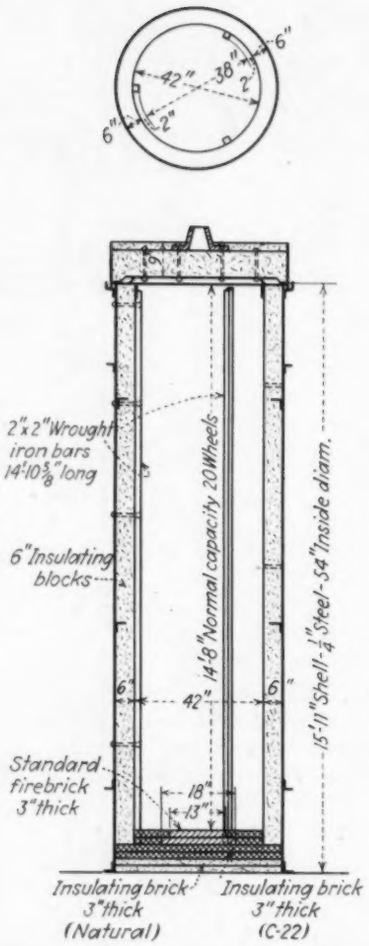


FIG. 2—This new type of car wheel annealing pit is designed to hold 20 to 22 wheels. Light-weight insulating refractories permit uniform de-heating along a known cooling curve. Although two pits are often used, recent refractory research has indicated success using only one pit, even though the refractories in such a pit must handle a great quantity of heat in a small time interval in a uniform manner.

To examine a typical example, consider the slow cooling process of chilled iron car wheels in pits. The wheels are delivered hot, the temperature being about 1550 deg F., and this heat is dissipated uniformly through the refractory walls. The problem is not so much one of refractory insulation, but one of handling the absorbed heat at a uniform rate. For such work the theoretically ideal lining would be one based on the principle of heat isolation by "massless type insulators," in which the heat storage capacity would be nil.

The old style pits consisted of a steel shell lined with fireclay brick, arranged in batteries with a sand fill around the pits. Auxiliary heat was usually supplied through the pit cover. In this type of construction it is very difficult to maintain uniform temperatures in the pits throughout the annealing cycle. This resulted in a loss of some wheels, or the necessity for double annealing.

Subsequent experiments have indicated that a lining of low-heat capacity with a maximum of insulation and consequent small heat loss will give far better results. Two-stage annealing is now prevalent and experiments are being made to determine the practicability of single-stage annealing. The results indicate that in order to get uniformity of annealing temperature throughout the pits, it is necessary that the heat loss be kept at a minimum, or at least uniform in the various zones of the pit. On the other hand, a temperature drop sufficient to permit removal of the wheels in one-stage pitting would require a rather rapid heat release. The problem of one-stage vs. two-stage pitting may at first appear to be unrelated to the subject of refractories, but it nevertheless serves as an example of one of the problems which confront operating men in making decisions concerning the utility of various refractory and insulating brick for their individual requirements.

The perfect massless furnace lining is a practical impossibility, but the refractory manufacturers have successfully approximated such material with low-heat-storage and low-heat-conductivity blocks. These blocks weigh about 30 to 50 lb. per cu. ft., compared with firebrick at 130 lb. per cu. ft. The heat storage and conductivity are proportionally lower. One insulating block has the following characteristics: At a mean temperature of 500 deg. F. the thermal conductivity is 0.56 B.t.u. per sq. ft. per in. per hr. per F. deg.; at 1000 deg. F. the conductivity is 0.70, and at 1500 deg. the conductivity is 0.84. This brick has a specific heat of 0.25, weighs 30 lb. per cu. ft. and has a crushing strength in the neighborhood of 100 lb. per sq. in.

An essential requirement for wheel pit linings is that the inside face temperature of the lining should equal that of the metal in the least possible time after the wheels are stacked in the pit. With this in mind, consider the comparative time required for the pit lining to attain the metal temperature, that is, the time when the lining

A large, spiral bevel pinion on the Gleason Surface Hardening Machine

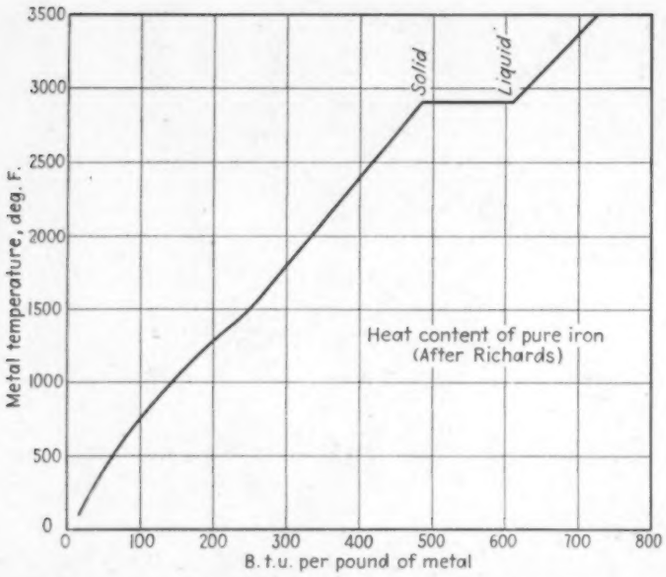


FIG. 3—Such a standard curve as this for pure iron is of great help in figuring the loads on furnace refractories. If this curve indicates the thermal characteristics of the metal on heating, a reverse action will take place during a de-heating cycle.

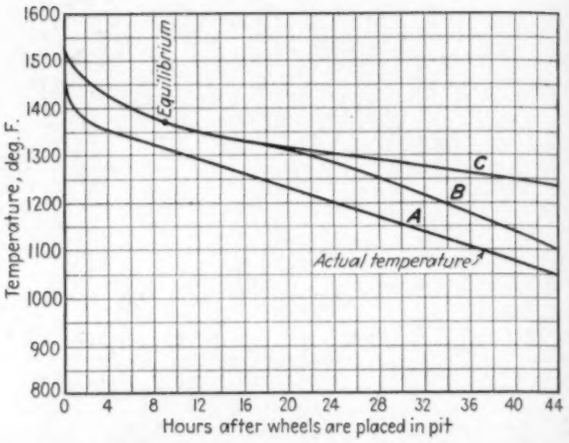


FIG. 4—Thermocouples in the wheel pit show the cast wheels cooling along curve A. Curve B is a theoretical calculated curve for the same conditions, and curve C is a theoretical calculated curve considering the wheels as made of pure iron and the pit made of a slightly different brand of refractory than for curve B. At the point marked equilibrium, the refractory is no longer absorbing heat, and as time progresses after that point there is a general uniform dissipation of heat from the refractories and wheels.

is made of firebrick (130 lb. per cu. ft.), as against an insulating block lining (30 lb. per cu. ft.). Tests have shown this comparative time as being a ratio based on the relative heat storage capacity for the same insulating effect. The insulating value of a 1-in. block is equivalent to 9 in. of firebrick. Both are made of fireclay, and the heat storage per pound therefore is the same; the relative weights of linings will be the same as the rela-

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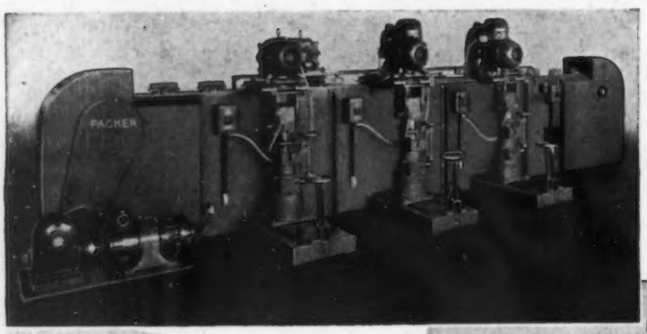

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tive heat storage values, which in turn is the same as the relative time for lining to attain the temperature of the wheels.

One square foot of firebrick wall 9 in. thick has a heat storage capacity of 97.5 B.t.u. (9/12x130), and 1 sq. ft. of insulating block wall 1 in. thick has a capacity of 2.5 B.t.u. (1/12x30). The insulating block attains the temperature of the hot car wheels in 2.5/97.5 or 1/40 of the time required by the firebrick. With this established, what will be the rate of cooling of 22 cast chilled car wheels weighing 750-lb. each when placed in the pit at a temperature of 1550 deg. F. The average pit temperature just as the wheels are stacked inside is 800 deg F., and the air surrounding the pit has a temperature of 120 deg. F.

The wheel pit shown in Fig. 2 has a diameter of 42 in. and a height of 14 ft. 8 in. It is lined with 6 in. of insulating block and equipped with 315 lb. of iron guides to protect the lining. The top and bottom of the pit have twice as much insulation as the side.

The first step in a de-heating calculation is the adoption of a reliable heat content curve, as for instance the one in Fig. 3, which shows the heat content of 1 lb. of pure iron at various temperatures. With this curve, the total heat content of wheels and the temperatures involved may be computed. The 22 wheels have a heat content of 4,252,905 B.t.u. (i. e. 750-x22x260), and the 315 lb. of metal guides at 800 deg. F. have a heat content of 34,650 B.t.u. (i. e. 315x110). Therefore the total heat in all the metal is 4,287,555 B.t.u., and the specific heat content of all metal is $\frac{4,287,555}{16,815}$ or 254.9 B.t.u. per lb. From Fig. 3, the equivalent temperature of iron having such a heat content is 1523 deg. F.

The radiant heat intensity of iron at 1523 deg. F. emitted to block insulation at 800 deg. F. approximates 11,000 B.t.u. per sq. ft. per hr. However, the insulating block will not accommodate more than 500 to 1000 B.t.u. per sq. ft. per hr., and therefore will attain equal inside surface temperature in 2¾ to 5½ min. That is, face temperature will be obtained before thermocouples with quartz tubes can overcome their time lag and indicate any temperature difference.

It is now necessary to calculate the heat propagation in the insulating block, following the procedure outlined in the article on page 27 of the March 27, 1938, issue of THE IRON

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PICKLING TANKS

THE above picture shows one of eight tanks of a double line continuous pickler recently installed in one of the large steel plants in Cleveland. Each line consists of four 60 ft. pickling tanks and two rinse tanks, designed to handle up to 106 inch strip—one of the widest sheet picklers in the country.

The tanks are of rubber lined steel. As a protection for the rubber lining our well known construction of a double sheathing of acid-brick and BASOLIT was used.

Including the tanks, all acid floors and sewers were brick-lined with BASOLIT joints.

The installation illustrated is one of many hundreds where BASOLIT has contributed toward long life and efficient operation of modern pickling equipment.

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AGE. This heat, which is reflected from the car wheels, is deducted at the different time periods, and the weight of the wheels is divided into the remaining heat content to obtain the amount of heat per pound of metal still to be dissipated. When obtained, these are plotted against the temperatures secured from the graph in Fig. 3, and one of the curves shown in Fig. 4 is obtained, which indicates the rate of cooling for the particular de-heating pit under investigation.

In the de-heating furnace described, the rate of de-heating (22 wheels and iron guides) and the temperature drop are indicated in the following table:

Time in Hr.	Heat Content, B.t.u.	Temperature, Deg. F.	Heat Content, One Pound Pure Iron, B.t.u.
Start	4,287,555	1523	253
0.67	4,188,900	1501	249
1.00	4,144,300	1483	247
2.40	4,074,300	1461	243
4.17	3,944,859	1423	235
9.70	3,762,942	1371	224

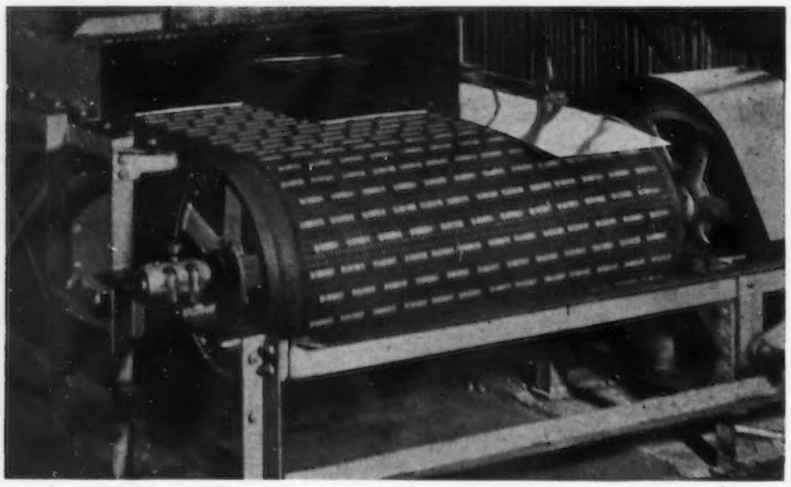
After the car wheels have been in the pit nine hours, the block lining and pit structure have a maximum saturation of heat, this point being marked as "equilibrium" on the curve in Fig. 4. After this point has been passed there is a general uniform cooling, as shown in the following table:

Time in Hr.	Heat Content, B.t.u.	Temperature, Deg. F.	Heat Content, One Pound Pure Iron, B.t.u.
16	3,590,042	1332	214
36	3,283,842	1256	195
44	3,194,850	1244	190
75	2,980,000	1202	178

Referring to graphs in Fig. 4, curve A represents the approximate actual temperatures obtained during the de-heating, curve B is a calculated curve for the same de-heating period in the pit, and curve C is based on the pure iron heat content. The greater apparent amount of heat in the latter may be the result of an actual physical difference, although all such calculations are subject to considerable error.

Recent years have seen many changes in heat treating furnaces, particularly in sheet mills where the annealing cover is carried by an electric crane and placed over a stack of coiled or flat sheets. The covers are gas heated, and the fuel is burned in tubes which radiate their heat to the metal. This arrangement is well known for its flexibility and close control of temperature.

It is a safe guess that car wheel foundries will soon adopt the same practice, and either the present form of pit will be used with a pressure-gas fired radiant tube cover with temperature controls, or a complete change may result where the wheels are collected 20 high and placed on a foundation, and a pressure combustion-gas fired cover with accurate controls brought to and placed over the wheels in much the same manner as in sheet mill practice.



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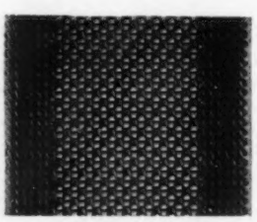
The photograph shows a Cambridge Wire Belt in operation on a W. S. Rockwell Company furnace that has paid dividends in high quality product and economical production. Aluminum cleats prevent the product from contacting the wires of the belt, thus avoiding the danger of product marking.

An exclusive Cambridge time and money saving feature is the Duplex Selvage which assures double strength at the belt's high wear point, guarantees extra hours of service and continuous operating efficiency. The open mesh construction provides low thermal capacity, even heat circulation and fuel economies.

The Cambridge engineer in your territory can help you plan an economical annealing process set-up. Consult him.



Section of "Cambriloy" Mesh Belt showing money-saving Duplex Selvage.

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Foundry Equipment Makers to Meet Oct. 21

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION will hold its fall meeting at the Terminal Club, Cleveland Hotel, Cleveland, Oct. 21. Subjects of interest to all manufacturers of foundry equipment will be discussed, Arthur J. Tuscany, executive secretary of the association, says.

PERCHLORIC ACID

o o o

By C. MORRIS JOHNSON

Chief Chemist, Crucible Steel Co. of America, Park Plant

o o o

PART I

A NEW technique for the determination of manganese, sulphur, nitrogen, molybdenum, tungsten and metallic iron in corrosion resisting steels, ferroalloys and iron ores. Also, sulphur and nitrogen determinations for coal and coke.

o o o

IN this series of articles,[1] the technique to be described has especial advantage for high carbon-high chromium steels, certain other alloys of iron, and, also, iron ores. Most analysts of iron and steel are familiar with the published pioneer work of H. H. Willard and G. Frederick Smith, of the University of Illinois, Urbana. The methods presented herein for manganese, sulphur, nitrogen, molybdenum, tungsten and metallic iron, to the best of the writer's knowledge, differ from previous publications by Smith and others, in a number of practical details, either wholly or in part. For instance, the determination of metallic iron and the perchloric method for manganese are believed to be substantially new applications. In addition, the perchloric-silver nitrate-ammonium persulphate scheme for the determination of manganese in the presence of any amount of chromium is an outstanding example of a new procedure.

[1] Manuscripts received Jan. 10, 1937. To be published in seven parts, of which this article is the first. Published by permission of the executive department of Crucible Steel Co. of America.

Further, the role of perchloric acid in simplifying and therefore speeding up the quantitative analysis of coal and coke for nitrogen and sulphur is different in some details; for instance, the digesting and solution period takes but two hours for the nitrogen.

Also worthy of note is the use of highly corrosion resistant steels, as for instance the Rezistals, in the construction of permanent hoods for the carrying away of corrosive and dangerous fumes. In this way heavy stone construction and warping and leakage of wooden frame work are avoided. Certain grades of these steels are superior to the usual commercial materials for this particular purpose. Daily use for three years of steel

FIG. 1—A Rezistal hood of this type is far better than a wooden hood for perchloric acid determinations. If wood hoods are used they should be washed down frequently to prevent charring.

chambers resistant to acid and other corrosive vapors has indicated that, with a little care, such an installation will last a long time in vertical parts and frames. And by adopting standard sizes and bolted construction, such structures can be taken apart and moved to other buildings if it ever becomes expedient to change location or to erect new laboratories.

In the seven parts of this article, the results of Crucible Steel's experience with perchloric acid in developing improved procedure will be recorded practically in full, particularly as applied to highly alloyed corrosion and heat resisting steels. Those steels containing considerable chromium, molybdenum and other carbides will be dealt with. In certain steels such carbides are most insoluble, even in aqua regia mixtures, when previously thrown out of solid solution by holding the steel at annealing heats. This carbide precipitation is caused in high carbon-chromium steels at almost any temperature that will render the specimen soft enough to drill, particularly in the chromium-molybdenum steels of higher carbon and chromium content.

The ready water solubility of many of its chromium salts is a real advantage in silicon determinations in high chromium steels. However, there are numerous cases where the chlorates formed during the process have a decided tendency to crystallize out (more so than chlorides or sulphates), but this is not a serious obstacle. The addition of considerably more water will dissolve these chlorate crystals.

The writer has found perchloric acid of great value in the determination of nitrogen in high chromium steels which form carbides that are insoluble in dilute hydrochloric and sulphuric acids, for the reason that the bulk of the nitrogen is in the insoluble carbides. Especially is this true in steels containing also appreciable amounts of titanium. Such steels yield only a part of their nitrogen by the old solution methods. The nitrogen in these steels is mainly concealed in the insoluble carbides. Perchloric acid, under proper conditions, will completely decompose these carbides, putting the same into solution from which the nitrogen can be obtained by Allen's distillation process, as adapted to carbide steels by the writer's laboratory.[2] Confirming other investigators, it has also been found that heating with perchloric acid, together with certain catalyzers or oxidizers, is a rapid way to dissolve coals and cokes for nitrogen.

[2] C. Morris Johnson, "Method for Nitrogen in Corrosion and Heat Resistant Steels," THE IRON AGE, July 26, 1934.

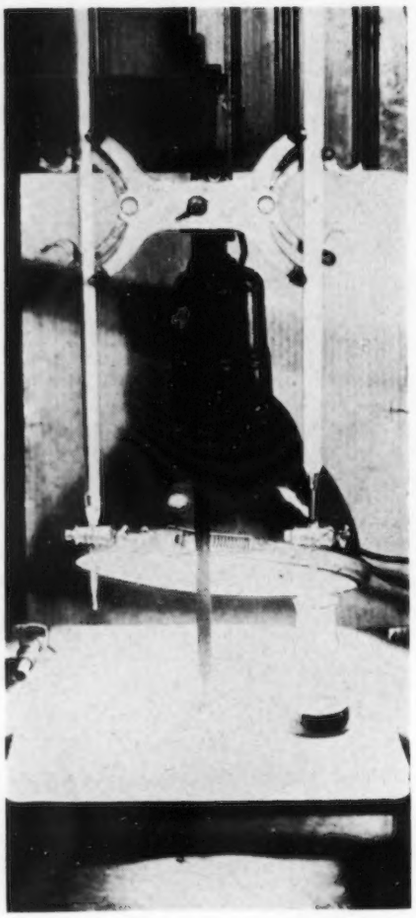


FIG. 2—Titration is best made in front of an angle reflector lamp, such as this. The reflector is protected by a clear glass cover to prevent corroding of the white enamel.

In sulphur determinations, the combination of oxidizing solutions given herein has proved as effective in getting total sulphur as by the best of fusion methods, even in anthracite coal and coke. Also a simplified scheme for nitrogen determination is included.

The Crucible laboratory of the Park Works has also standardized analytical practice for the use of perchloric acid in the determination of phosphorus, silicon, chromium, vanadium, nickel, titanium, columbium, tellurium, tantalum and selenium, and arsenic in carbide steels, and in acid and basic open hearth slag. However, lack of space prevents the publication of these latter procedures in this series of articles.

Explosions Possible

Perchloric acid must not be used indiscriminately in oxidations, as dangerous explosions can be produced by heating this powerful oxidizer alone with some forms of carbon compounds that explode when too rapidly oxidized. Therefore, it is imperative that dust be kept off the hot floors of hoods or it will flash fire with $HClO_4$ fumes and may explode with sufficient force to blow out hood windows. This has happened.

Too much emphasis cannot be put on care when using fuming perchloric acid. Therefore, it is deemed important to first tabulate the necessary safety precautions before proceeding to give analytical details. Someone thereby may be saved from disfiguring burns or loss of eyesight.

Do not pour water, or ammonia water, or other solutions containing water, into hot, boiling, fuming perchloric acid. In all cases cool the perchloric solution to nearly room temperature beforehand.

Perchloric acid has a strong tendency to spurt if taken to boiling and fuming temperature in too deep a layer. Wherever possible use large beakers to thin out the layer—800 ml. beakers are preferable for a minimum of spurting.

Hood windows should be kept nearly closed when boiling perchloric acid at fuming temperature.

Do not handle beakers containing hot perchloric acid with beaker tongs covered with rubber. Use tongs covered with asbestos.

Do not use rubber thumb stalls when handling beakers containing fuming perchloric acid, as the rubber is liable to catch fire.

Do not use paper labels, as they char and sometimes explode.

Keep the dust swept off the bottom of hoods, as this dust gets saturated with perchloric acid fumes and will cause a fire to flash across if the heat becomes too great.

Keep all carbonaceous material such as paper, rubber, dust, etc., from contact with hot, fuming perchloric acid.

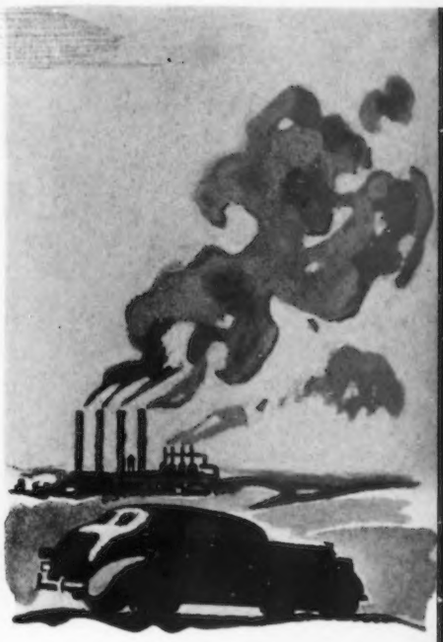
Explosions have resulted from heating perchloric acid with alcohol, etc.

Avoid evolution of much hydrogen in the same hood.

The interior of hoods, where wood is used, should be washed off fairly often, to prevent accumulation of perchloric salts.

The Crucible laboratory is gradually replacing all old wooden hoods with hoods built entirely of Rezistal, there being no wood exposed to perchloric acid fumes except a little in the frames of the sliding doors (see Fig. 1). Perchloric acid will in time char all woodwork.

If proper precautions are taken there is no more danger from fuming



Steel or Gold?

It is just as important to save steel as to save gold. Our civilization stands on steel. Steel is a million indispensable things.

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That's only one saving, made by only one product out of a score now standard the world around. They all save iron or steel in one way or another.

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RODINE: The standard pickling inhibitor. Used in about 95% of all pickling operations.

DEOXIDINE: Eradicates rust; removes or neutralizes rust-producers; produces an etched and passive surface for painting. The standard protector of automobile bodies.

Electro-GRANODINE
Spray-GRANODINE
Dip-GRANODINE
Provide a perfect bonding surface that holds the paint and prolongs its life.

Thermoil - GRANODINE: Transforms the rasping surface of steel into a gliding surface of phosphates integrated with the metal; prevents corrosion, maintains lubrication, and greatly reduces wear on bearing surfaces.

CROMODINE: The chemical used in a simple but effective process for increasing the life, and the adhesion to steel, of paint, lacquer or enamel finishes.

LITHOFORM: Coats electro and hot-dip galvanizing, zinc die castings and cadmium plate, so that paint will adhere.

KEMICK: A manifold paint that can't burn off.

FLOSOL: Self-cleaning liquid, paste and cream soldering fluxes.

Literature and all technical information on request. The results of our research, and the practical experience of our engineers and chemists, are at your service.

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perchloric acid than there is in handling fuming sulphuric acid.

Carboys of perchloric acid should be stored in a separate, cool place, away from other chemicals, wood boxes, pasteboard cartons and packing such as excelsior.

Use light weight, plain glass spectacles when observing perchloric operations, unless lenses are already worn to correct vision.

Test all gas connections for leaks, as even small leaks might cause enough gas accumulations to result in bad explosions with fuming perchloric acid.

Do not use more than 150 to 200 mgs. of organic compounds such as coal, coke or acids, when digesting the same for phosphorus or sulphur determinations. Larger amounts might cause explosions.

Start with 1:1 $HClO_4$ where possible. In steel analyses do not start with $HClO_4$ of over 60 per cent concentration.

Further Precautions

When dissolving compositions likely to cause explosions, such as rubber or coke or coal dust, or other organic compounds, never start the decomposition with $HClO_4$.

First digest as far as possible with HCl, or HCl + HNO_3, or HCl + $K_2Cr_2O_7$, or $KMnO_4$ + HNO_3. Then follow with 60 per cent $HClO_4$ (not 70 per cent) and boil down to heavy fumes of the $HClO_4$.

Bad explosions have occurred when digesting oil or alcohol. Most likely these were caused by heating, at once, with concentrated $HClO_4$, and using too much of the oil or alcohol. However, this laboratory has had no experience with these two latter high inflammables.

Rapid Determination of Manganese

In the Park Works laboratory, which has to serve a daily routine of manganese determinations in high chromium steels of every description, alloyed with nickel, or molybdenum, or chromium, or silicon, etc., or all together, with a manganese range of 0.20 to 14 per cent, perchloric acid has enabled the development of a method that is believed to be new in its technique. It is practically universal in application, as chromium, molybdenum, tungsten, vanadium or cobalt do not have to be separated. It is the most outstanding aid of all in the laboratory's practice, as it eliminates all filtration. It quickly secures the complete decomposition and solution of any carbides. In high carbon-high chromium-high manganese-high copper steels the carbides, even after attack by aqua regia, will be in part still soluble, without $HClO_4$. This portion may retain as much as 0.2 per cent manganese in a possible 4 per cent.

The most recent publications on the analysis of steels for manganese specify that chromium in excess of about 2 per cent must be removed by zinc oxide or sodium bicarbonate before proceeding with the determination of manganese. For example: Committee E-3 of the A.S.T.M., "Methods of Chemical Analysis of Metals," 1936; also the A.S.M., Metals Handbook, 1936, in the chapter, "Methods of Chemical Analysis of Steel," the latter being the result of the cooperation of ten steel laboratories of representative steel plants. Both publications specify the preliminary removal of chromium.

In the author's process, the chromium interference is prevented without extra operations. *Perchloric acid is essential.*

$HClO_4$-PbO_2 for High-Cr Steels

The first method brought to successful operation by the writer by means of $HClO_4$ oxidations, is to convert all of the chromium to chromate as red crystals of dichromate by fuming the solution heavily with perchloric acid. Then dilute and boil with PbO_2. The manganese present becomes permanganate. The chromate is changed to an insoluble lead compound which is filtered out along with the excess of PbO_2 on an asbestos pad. The pink filtrate and washings are titrated with sodium arsenite to the disappearance of all pink and brown shades, in the customary manner. This method will be described in detail, as it led to the final method which avoids also all filtrations and separation of chromium.

Method for High-Cr Stainless

After using the $HClO_4$-PbO_2 method for a time, it was decided to produce the red dichromate crystals and then try the well known silver nitrate and ammonium persulphate oxidation to develop the permanganate pink solution in the presence of chromates. To do this, dissolve 0.04 to 0.100 gm. in 10 ml. 1:1 HCl. Fume with 6 ml. 60 per cent $HClO_4$. After fuming heavily for one minute to convert all the chromium to red crystals as in the first method, the solution is cooled, 15 ml. H_2O are added and the chloric acid smell boiled off for three minutes. Then 10 ml. $AgNO_3$ and next 15 ml.[3] of ammonium persulphate are added. Bring to a boil and boil for three minutes (the volume is about 40 ml.), then cool. Now, instead of a pink solution, a clear, deep reddish-brown liquid confronts the analyst, which closely resembles the color of bromine water. The depth of the brown color depends on the amount of manganese present.

This combination is titrated with sodium arsenite until the brown color is gone and a yellow liquid remains. As the brown color becomes faint, it is necessary to have a foil consisting of 100 mg. of No. 55a ingot iron to which has been added a weighed amount of $K_2Cr_2O_7$, giving a chromium content about equal to that of the samples being tested for manganese at the time. Put this through all operations. This method is new, as it is a successful quantitative titration of a large range of manganese in the presence of any amount of chromate in solutions of iron. Titrations once begun must proceed without interruption, as the permanganate tends to return shortly after the yellow end point is reached. Also titrations should begin as soon as solutions are cold.

This procedure has been found to be accurate for technical purposes in any range of alloy steels, as for example, with the manganese percentage in the vicinity of 14 per cent, or as low as in ingot iron. (Previous to developing this second scheme the first method had been used, as thereby the separation of chromium by ZnO or $NaHCO_3$ was also avoided. However, one filtration is required to remove PbO_2 and chromate lead compounds.) In the second method, the titration to disappearance of the red-brown color is best made in front of a 12-in. angle reflector lamp (see Fig. 2), which is a Westinghouse reflector lamp, style No. 349818, with a white enamel reflector. The reflector is enclosed and protected by a clear glass cover, which prevents the white enamel from becoming corroded, rusty and spattered. The lamp is supported within a few inches of the white glass base of the titrating stand, on which are placed the test and its foil. Both the latter are at the same volume at the finish of the titration. Foils can be stoppered and used repeatedly. Reverse the positions of the test and the foil, as the brown color of the former becomes faint, near the end point.

This red-brown color is merely an effect of the red dichromate color

[3] 6 gm. $AgNo_3$ per 1 liter; 240 gm. ammonium persulphate per 1 liter.

The Sun Never Sets... on Monel Pickling Equipment

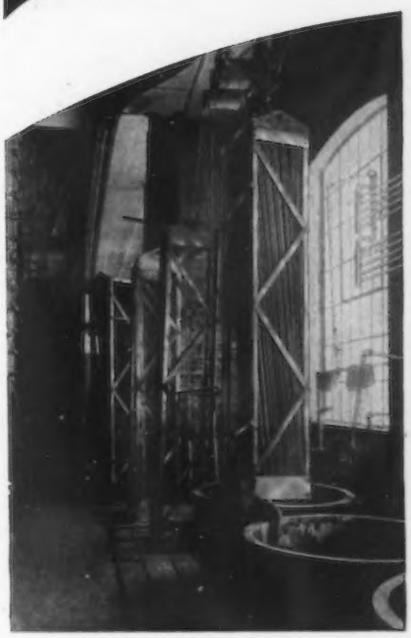
High strength combined with stout resistance to corrosion wins world-wide preference for Monel

A tube plant in Canada, a steel hollow ware factory in Australia, a tractor plant in Soviet Russia, steel mills in England and Belgium . . . in all of these places you find pickling equipment made of Monel.

Monel's exclusive advantages are utilized for pickling equipment in every quarter of the globe. Combining corrosion resistance and strength, Monel makes possible strong, lightweight construction that cuts out dead-weight, reduces power costs, and increases payload. Monel's unusual properties also assure years of trouble-free service, with a minimum of repairs and replacements.

Write for further information on Monel. Ask for "Equipment Designs for the Pickle House" and "A Good Start to a Better Finish." Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.

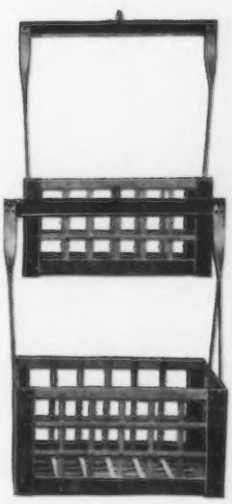


CANADA: All Monel crates used for pickling conduit pipe prior to galvanizing in the plant of a prominent Canadian company. The crates are two feet square and ten feet six inches high.

AUSTRALIA: Messrs. Chown Bros., Sydney, Australia, use Monel baskets of this type for pickling steel hollow ware prior to enameling. The basket shown has been in use three years in hot sulfuric acid with no sign of corrosion.

ENGLAND: One of the largest tube producers in England uses these Monel crates for pickling steel tubes. Although riveted construction is quite suitable for this type of basket, improvements in welding technique in the U. S. have been such as to indicate this method of joining to be even more satisfactory.

BELGIUM: Monel chains supplied to "Les Tubes de la Meuse" (steel tube drawers, Belgium). The chains were manufactured by a Brussels metal worker and are used in the pickling of steel tubes.



RUSSIA: Two of twelve Monel pickling baskets built by Klaas Machine and Mfg. Co., Cleveland, Ohio for export to Russia. The baskets are used in the forging division of a tractor plant.

"Monel" is a registered trademark of The International Nickel Company, Inc., which is applied to a nickel alloy containing approximately two-thirds nickel and one-third copper.

blended with the pink of the permanganate. It is possible to quickly reproduce this bromine-like tint by mixing a water solution of $KMnO_4$ and $K_2Cr_2O_7$ in the same proportions as in the high-chromium steels.

High Speed Steels of 18-4-1 Type

In the method for 18-4-1 high speed steels, the tungsten does not need to be removed. The drillings are first decomposed by heating them in a 125 ml. cone flask with 10 ml. concentrated HCl. Then cool, and add 50 mg. of $KClO_3$. Then, boil to a syrupy state with the cover on. Rinse down the cover and side walls of the flask with a H_2O jet, and pour in 6 ml. of 60 per cent $HClO_4$. Boil down to heavy fumes and fume in a heavy cloud for one minute. Cool, and then rinse the lid and side walls of the flask, and add 10 ml. of H_2O. Boil with the lid off for three minutes to remove chloric odors. Cool, and then add 10 ml. $AgNO_3$ solution and 15 ml. persulphate, and boil vigorously with the cover on for three minutes. Cool in running water to 50 deg. to 60 deg. F. Finally titrate with arsenite to disappearance of the brown color, ignoring the presence of the yellow tungstic acid.

Directions for Titrations

Do not run more than about 20 weights, including standards, at one time.

Begin the titrations promptly, when the solutions, cooling in running water, are cold.

Do not titrate out the brown color, or pink color at too high a burette speed. On the other hand, if the titrations are too slow, the permanganate will start to form again. A proper speed is 60 sec. per titration, including frequent comparisons with the foil.

Keep both foil and test resting on the white plate of the burette stand when comparing the two.

As the end point is near, compare the foil and test frequently. Do not depend on a memory of color intensity.

Results With High Speed Steel

Following are the results obtained by the perchloric + persulphate + silver nitrate method applied to high speed steel. (High tungsten-chromium-vanadium steel.) (On a 0.100 gm. basis.)

United States Bureau No. 50a high speed steel standard plus 40 mg. $K_2Cr_2O_7$ gave a factor of 1 ml. arsenite, equaling 0.059 per cent Mn when 0.1 gram of sample was taken.

United States Bureau No. 101 stainless 18-8 standard plus 2 mg. V_2O_5 plus 20 mg. tungstic acid gave a factor of 1 ml. arsenite, equaling 0.060 per cent Mn on a 0.1 gram basis.

The same factors applied to United States Bureau high speed steel standard No. 50 plus 40 mg. $K_2Cr_2O_7$ gave 0.216 per cent Mn. Official value of standard 0.205 per cent Mn. .

The same factors applied to United States Bureau high speed steel standard No. 50a plus 40 mg. $K_2Cr_2O_7$ gave 0.282 and 0.276 per cent Mn. Official value of standard = 0.287 per cent Mn.

The same factors applied to high speed steel heat 273 gave 0.312 and 0.306 per cent Mn. The PbO_2 (old standard method) gave 0.32 per cent Mn. These titrations were done in the presence of the yellow tungstic acid.

Thus far all of our tests have shown that vanadium in solution interferes but slightly, if at all. It is an easy matter to add an equivalent amount of V_2O_5 to non-vanadium steels such as No. 101 United States Bureau of Standards standard "18 and 8" if it is so desired to do so to take care of any color effect of the V_2O_5 in the solution.

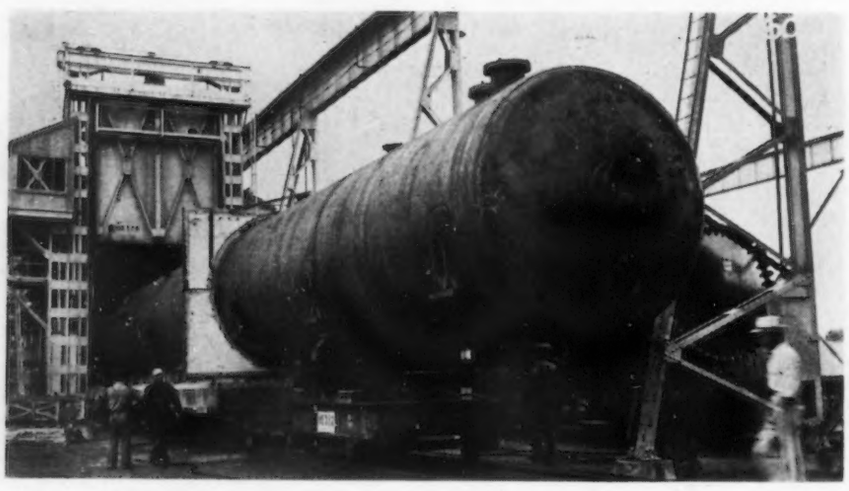
Low-Chromium Steels

Following are the results obtained with the perchloric + silver nitrate + persulphate method for manganese in low-chromium steels. Perchloric acid is a very efficient one, in our experience, in which to perform the $AgNO_3$ + $(NH_4)_2S_2O_8$ oxidation of manganese to $KMnO_4$ in low-chromium steels. The writer has seen the No. 100 United States Bureau 1.39 per cent manganese standard become completely and automatically reoxidized at room temperature after titration, three times. This was without any further addition of the oxidizers, or any reheating. The pink color recurred each time, quantitatively, after retitrating to remove the permanganate pink.

* * *

Ed. Note—The second section of this series of articles on the use of perchloric acid will follow in a later issue of THE IRON AGE.

Long Digester Stress Relieved in Sections



THE accompanying view shows a 9½ ft. diameter by 85 ft. 2 in. long digester being stress relieved at the Birmingham plant of the Chicago Bridge & Iron Co. The structure was fabricated for the Aluminum Ore Co. of East St. Louis, Ill.

This view is of particular interest because it shows a structure being stress relieved which is longer than the new furnace at the Birmingham plant. The furnace will take vessels up to 80 ft. long in one charge. In this instance, the vessel to be treated is permitted to project out of the furnace, the space around the vessel being bricked in temporarily. After the end which is placed in the furnace is stress relieved it is allowed to extend out, and the part at the other end and the remainder of the vessel is stress relieved.

Tool Engineers Gather in Pittsburgh for Convention

MORE than 1000 members of the American Society of Tool Engineers are expected to gather Friday, Oct. 14, at Pittsburgh for a two-day meeting during which Dr. L. W. Chubb, director of research, Westinghouse Electric & Mfg. Co., and J. H. Van Deventer, editor of THE IRON AGE, will speak.

The convention will open Friday with visits to Carnegie-Illinois Steel Corp.'s Homestead works, plants of the Aluminum Co. of America, Mesta Machine Co., Firth-Sterling Steel Co., and Westinghouse Electric Company, the Mellon Institute and other points of interest in Pittsburgh.

Mr. Van Deventer's address before the convention will be on "Tools, Taxes and Wages," while Dr. Chubb will present a paper on "Industrial Advancement Through Scientific Research." James R. Weaver, first vice-president of the A.S.T.E., is chairman of the local committee, which includes E. D. Gangwere, I. M. Dinger and J. H. Thomas, Westinghouse tool engineers. E. C. Batchelor, district manager, Motch-Merrywether Co., M. F. Judkins, chief engineer, Firth-Sterling, and J. P. Wiley, general foreman, National Tube Co., were active in arranging the entertainment and plant visits.

DR. L. W. CHUBB

J. H. VAN DEVENTER

J. R. WEAVER

I. M. DINGER

J. H. THOMAS

E. D. GANGWERE

THIS WEEK ON THE ASSEMBLY LINE

o o o

By W. F. SHERMAN
Detroit Editor

o o o

. . . Flood of retail orders greets new car announcements . . . Production boosted 50 per cent in week . . . Ford announces new Mercury Eight.

DETROIT—An unprecedented volume of advance retail orders, recorded not by one but by several automobile companies, speaks volumes for the prospects for 1939 business. Widespread response to the first announcements of new cars has pushed production totals upward, accounting for a 50 per cent increase in the last week following two successive weekly increases of 25 per cent in automobile output.

In one case it was announced that the brighter outlook was responsible for a revision in 1939 prices to a level even lower than had originally been planned.

Increased output resulting from growing sales volume is bringing sharp gains in employment in Detroit and Michigan. The local job index jumped to 72.1 at the turn of the month, compared with 62.6 two weeks earlier.

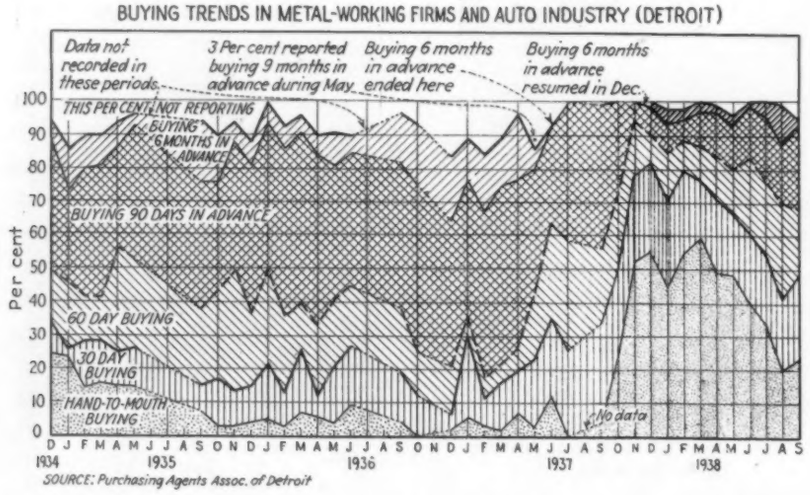
Production volume is expected to continue its upward movement and employment will continue its rise unless new-born agitation by the UAW thwarts all present plans. There is indication also that public announcement of the much-anticipated Ford Mercury will loosen many more orders from customers in this price class (about $900) who have been waiting to see the new Ford product.

Output for the last week was placed at 37,665 passenger cars and trucks in the United States and Canada, in the last weekly estimate of Ward's Automotive Reports. This figure compares with 25,405 in the previous week and 71,958 for the industry a year ago. Possibility of exceeding the 50,000 mark during the current week exists and, if this occurs, the industry will be back to the level last traversed in early May. More than half of the increased volume is attributable to the growth in Chevrolet production from 1000 in the week ended Oct. 1 to 8500. Ford also spurted, jumping assemblies from 615 to 1815 as new models began to roll off the assembly line. The Ford output included a few new Mercurys, it was reported, but this assembly line will not get in full swing for a few more days. It will hit its peak after the usual starting pains are cured.

Word from Graham late last week indicated that shipment of new models would start about Oct. 17, next Monday. One thousand men were recalled to work late last week in the body department to start production of 1939 models. In addition, Graham expects to resume operation in the tractor department on a basis of 25 units a day.

Two shifts were called to work at the Oldsmobile factory in Lansing this week because, General Manager C. L. McCuen announced, indication of a general improvement in business, coupled with a record volume of advance retail orders, called for sharply increased production. The brighter outlook was responsible also for a revision in 1939 prices. As a result, reductions are greater than were first scheduled. The Series 70, the large six-cylinder car, is cut only $33 to $43, delivered price. But the light six has been reduced $96 to $106 on various models, and the Oldsmobile Eight is down $64 to $69. Oldsmobile Automatic Safety Transmission, in-

BUYING TRENDS IN METAL-WORKING FIRMS AND AUTO INDUSTRY (DETROIT)


Data not recorded in these periods
3 Per cent reported buying 9 months in advance during May
Buying 6 months in advance ended here
Buying 6 months in advance resumed in Dec.
THIS PER CENT NOT REPORTING
BUYING 6 MONTHS IN ADVANCE
BUYING 90 DAYS IN ADVANCE
60 DAY BUYING
30 DAY BUYING
HAND-TO-MOUTH BUYING
No data
Per cent
100
90
80
70
60
50
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D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
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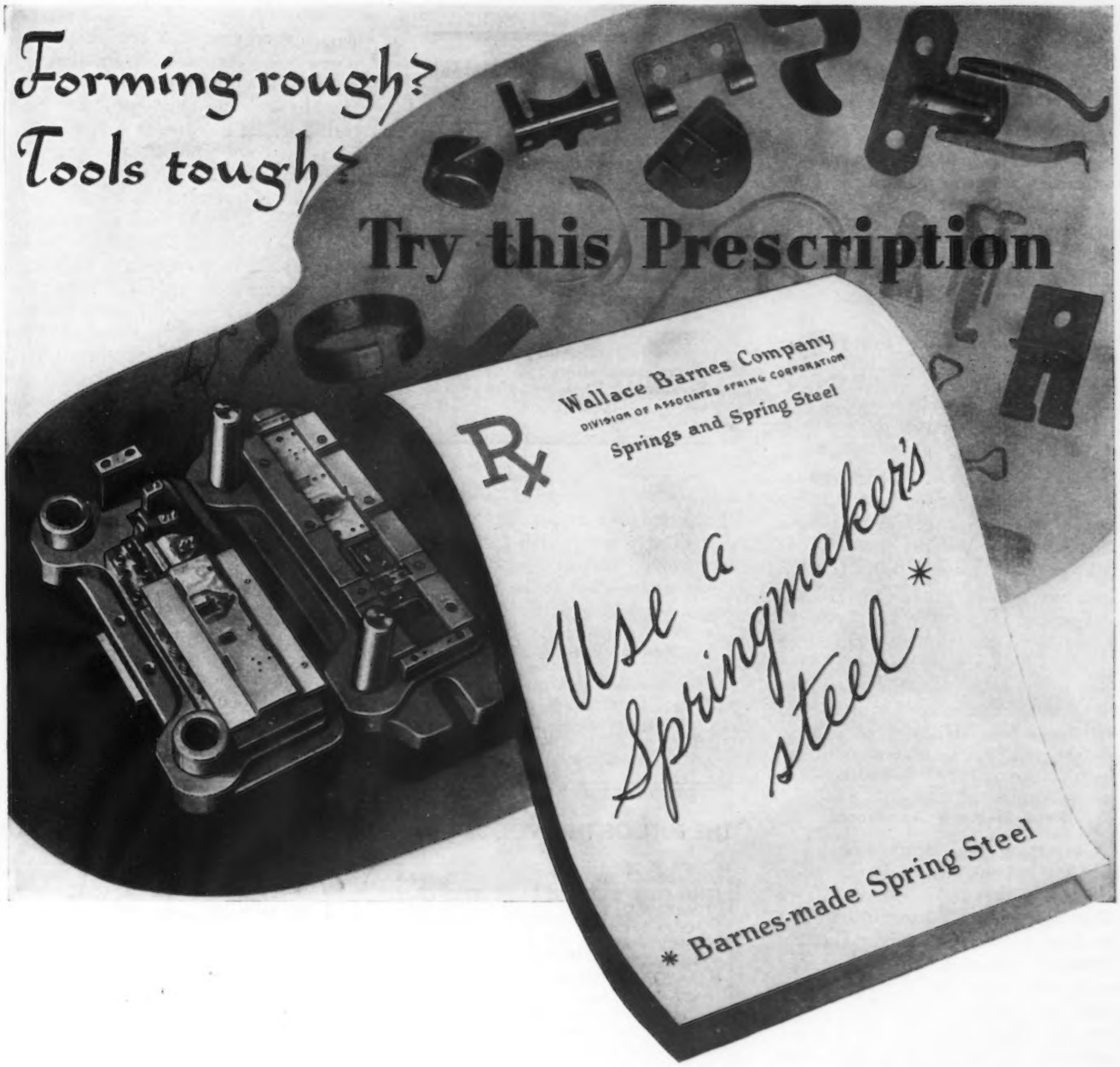
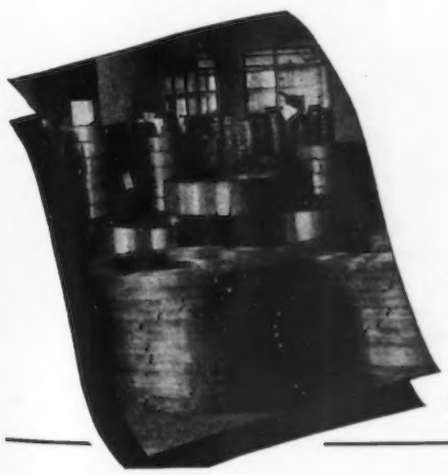
SOURCE: Purchasing Agents Assoc. of Detroit



Ample warehouse stocks insure prompt deliveries . . . Write the Steel Sales Department for a list of sizes . . . or a quotation.



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troduced more than a year ago, costs $25 less than it did then.

Buick Sales Large

Buick continues to set the pace for the rest of the industry as far as retail orders are concerned. W. F. Hufstader, general sales manager, has announced that the bank of orders is higher than it has been for any announcement period in the last 10 years. The company has 62 per cent more unfilled orders than it did at this time last year, approximately five times as many orders as the year before last and 56 per cent more orders than at the time of the 1936 model announcement. Probably 25,000 Buicks have been put into the field; more than 14,500 were produced during September alone, and output was sharply stepped up the last week of September when an extra shift of workers was called into the plant.

Reductions in prices on Hudson cars ranged from $30 to $112, with the exception of the Hudson 112, which is in the lowest price field. This car costs substantially less than last year's model would cost today with the extra equipment now standard, so that an equivalent of a price reduction actually is offered.

Ford Mercury Announced

Confirming the information about the 116-in. wheelbase Ford model which was first published last March 17 in The Assembly Line, Edsel Ford, president of the Ford Motor Co., last Thursday announced that a new car, to be known as the Mercury Eight, would be added to the Ford-Lincoln line shortly before the New York automobile show. It will, Mr. Ford said, have a 116-in. wheelbase, a more powerful V-8 engine than that in the present Ford, hydraulic brakes and Lincoln-Zephyr streamline styling.

When Hudson showed its cars for the first time last week, it displayed the Hudson 112, with 112-in. wheelbase and 86 hp. engine, the new Hudson six, with 118-in. wheelbase and 96 hp., and the Hudson country club series, including 122-in. wheelbase sixes and eights with 101 and 122 hp., respectively, and a special eight-cylinder sedan with 129-in. wheelbase. All cars bear the Hudson name, the Terraplane cognomen having been dropped. A departure in grille appearance was observed on the new models which have die cast main grilles, slightly larger than those which are popular this year on other models, and die cast side grilles with vertical louvers that are quite unobtrusive. It will be one of the few easily identified cars during the next year. The country club eights introduce long narrow parking lights which are worked in as part of the louver decoration on the hood side.

"THERE is an unmistakable start toward greater prosperity in America. Only a little push is needed now not only to take advantage of this start but to accelerate the pace into a real recovery movement. The return of more nearly normal buying of motor cars could and unquestionably would provide much needed stimulus."

—by Alvan Macauley
President, Automobile Manufacturers Association.
President, Packard Motor Car Co.

New Rubber Cushioning

As predicted nearly a year and a half ago, latex foam rubber cushioning has made its appearance in the passenger car field. A combination of a new coil spring seat construction and a heavy layer of rubber is offered in the Hudson. The new cushioning material, despite its extreme softness, supports the body firmly. It has been used up to now only in seats of airliners and streamlined trains, and in hospital mattresses and in the seats of a few makes of costly furniture. The Hudson hood, of one-piece construction, is hinged at the extreme front end. It is locked by a handle inside the car, under the instrument board. A mechanical type gear shift lever at the steering wheel is standard on the Hudson, with the Hudson "electric hand" shift available at extra cost.

New Type Brake Expected

An attempt to introduce a new type brake of the disk type (something like a disk clutch) is anticipated in the industry. It is reported that a prominent firm in the automotive parts field, or its leading official, has become interested in this development and will attempt to introduce it next year. On the subject of brakes, it has been learned that the American Brakeblok Corp. will be the principal supplier of brake lining

THE BULL OF THE WOODS — BY J. R. WILLIAMS

GOOD NIGHT! HUNTIN' BEFORE WORK! IT'S GUYS LIKE YOU WHO KILLED OFF TH' VAST HERDS OF BUFFALO THAT ROAMED THIS COUNTRY AT ONE TIME
YES, AND IT'S GUYS LIKE YOU WHO WOULD HAVE A BUFFALO IN EVERY BACK YARD!
HE'S RIGHT— THEY WOULD BE NOW IF THEY'D KEPT ON... IMAGINE A BUFFALO IN EVERY BACK YARD IN NEW YORK CITY!
NO, THEY ROAMED IN HERDS - THEY SAY TH' HERDS WAS SO BIG THEY'D HOLD A TRAIN UP FER HOURS... TRAFFIC LIGHTS DELAY ME LONG ENOUGH - I DON'T WANT NO BUFFALOES!
J.R WILLIAMS

THE HUNTSMAN

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material in the new Ford hydraulic brakes.

Evidence that management in the Detroit area has again tightened the purse strings is revealed in a current study of purchasing trends in metal-working firms and the automobile industry. The report of the Detroit Purchasing Agents Association, covering buying policy during September, indicates a slight upswing in hand-to-mouth buying and a considerable decrease in six months future purchasing. The change in hand-to-mouth buying amounts to only 3 per cent, but in the six-months group the drop is 9 per cent. Optimism in August led 11 per cent of the buyers to make their plans for the half year, but the September set-back has reduced the group to only 2 per cent. Eighteen per cent of the purchasing agents reported that commodity prices were moving upward, many of them prefixing a note that they referred particularly to non-ferrous materials. Inventories showed little fluctuation, as should be expected from the long period of buying for immediate needs only. The over-all report on this survey indicates that the trend has been tempered rather than reversed.

September Steel Ingot Output Highest in 11 Months

TOTAL tonnage of open hearth and Bessemer steel ingots produced during the month of September was the highest in 11 months and represented an increase of 4½ per cent over the August tonnage, according to the monthly report of the American Iron and Steel Institute.

September production totaled 2,657,748 gross tons, as against 2,546,988 tons in August and 4,289,507 tons in September of last year.

Output in the first three quarters of 1938 totaled 18,005,938 tons, a decline of 58 per cent from the total of 42,482,597 tons produced in the corresponding period of 1937.

During September, the steel industry operated at 46.28 per cent of capacity, which compares with 42.85 per cent in August and with 76.30 per cent in September, 1937.

For the third quarter of this year, operations averaged 40.79 per cent of capacity, which compares with 30.76 per cent in the second quarter, 31.58 per cent in the first quarter. In the third quarter of 1937, the industry operated at 79.58 per cent of capacity. Operations in the first nine months of 1938 averaged 34.41 per cent, as against 83.09 per cent in the corresponding period a year ago.

An average of 620,969 gross tons of ingots was produced per week during September, which compares with 574,941 tons per week in August and with 1,002,221 tons per week in September, 1937.

PRODUCTION OF OPEN-HEARTH AND BESSEMER STEEL INGOTS

(Reported by Companies Which in 1936 Made 98.29 Per Cent of the Open-Hearth and 100 Per Cent of the Bessemer Ingot Production)

	Reported Production (Gross Tons)		Calculated Production All Companies		Number of	Per Cent of Capacity
1937	Open-Hearth	Bessemer	Monthly	Weekly	Weeks	
January	4,349,024	292,209	4,718,436	1,065,110	4.43	81.32
February	4,011,852	331,629	4,414,699	1,103,675	4.00	84.27
March	4,730,943	403,400	5,218,326	1,177,952	4.43	89.94
1st Quarter	13,091,819	1,027,238	14,351,461	1,115,977	12.86	85.20
April	4,600,418	388,783	5,070,867	1,182,020	4.29	90.25
May	4,686,052	382,671	5,151,909	1,162,959	4.43	88.79
June	3,832,082	284,615	4,184,723	975,460	4.29	74.48
2d Quarter	13,118,552	1,056,069	14,407,499	1,107,417	13.01	84.55
1st 6 Months	26,210,371	2,083,307	28,758,960	1,111,672	25.87	84.88
July	4,147,227	335,456	4,556,304	1,030,838	4.42	78.48
August	4,425,998	373,259	4,877,826	1,101,089	4.43	83.83
September	3,950,899	268,472	4,289,507	1,002,221	4.28	76.30
3d Quarter	12,524,124	977,187	13,723,637	1,045,212	13.13	79.58
1st 9 Months	38,734,495	3,060,494	42,482,597	1,089,297	39.00	83.09
October	3,148,321	188,715	3,392,924	765,897	4.43	58.31
November	2,004,890	113,885	2,154,365	502,183	4.29	38.23
December	1,362,010	86,833	1,473,021	333,263	4.42	25.37
4th Quarter	6,515,221	389,433	7,020,310	534,270	13.14	40.68
Total	45,249,716	3,449,927	49,502,907	949,423	52.14	72.38
1938						
January	1,604,363	99,991	1,732,764	391,143	4.43	29.15
February	1,550,772	125,493	1,703,726	425,932	4.00	31.74
March	1,822,398	157,737	2,012,406	454,268	4.43	33.85
1st Quarter	4,977,533	383,221	5,448,896	423,709	12.86	31.58
April	1,762,315	131,644	1,925,166	448,757	4.29	33.44
May	1,647,049	130,590	1,806,805	407,857	4.43	30.39
June	1,493,148	118,688	1,638,277	381,883	4.29	28.46
2d Quarter	4,902,512	380,922	5,370,248	412,778	13.01	30.76
1st 6 Months	9,880,045	764,143	10,819,144	418,212	25.87	31.17
July	1,821,815	127,982	1,982,058	448,429	4.42	33.42
August	2,309,306	196,789	2,546,988	574,941	4.43	42.85
September	2,407,233	207,887	2,657,748	620,969	4.28	46.28
3d Quarter	6,538,354	532,658	7,186,794	547,357	13.13	40.79
9 Months	16,418,399	1,296,801	18,005,938	461,691	39.00	34.41

Automobile Men to Testify At Aluminum Co. Hearing

THREE Detroit men, long identified with the automobile industry, have been subpenaed to appear as witnesses in the anti-trust suit brought by the Department of Justice against the Aluminum Co. of America. The suit is being heard in New York. Those subpenaed were William B. Mayo, formerly chief engineer at Ford Motor Co., L. M. Payne, formerly purchasing agent for the Packard Motor Car Co., and now president of Aluminum Aircell Insulation Co., and Charles H. Reisdorf, construction engineer for Briggs Mfg. Co.

Tractor Prices For '39 Cut 5 to 12 Per Cent

FOLLOWING the lead of the Oliver Farm Equipment Co. and the Minneapolis-Moline Power Implement Co., the International Harvester Co. last week reduced prices of its all-purpose tractor line for 1939 from 5 to 12 per cent, effective immediately. The reductions in list price range from $30 to $110 on steel wheel tractors and from $68 to $140 on rubber tired tractors. A reduction of $20 in the price of the four roll all steel corn husker and shredder also was announced.

THIS WEEK IN WASHINGTON

. . . Monopoly Committee deluged with information as inquiry into nation's economic system broadens . . . Observers see signs of end to name-calling . . . Conciliation Commission may find temporary answer to rail problem.

o o o

By L. W. MOFFETT
Resident Washington Editor
The Iron Age

o o o

WASHINGTON.—The expanse of subjects being studied by the National Economic (Monoply) Committee is as broad as the ocean. Almost every conceivable question centering about the country's economic system is the source of consideration. Material being gathered indeed is so vast that its very volume, in the opinion of even "constructive" critics, may swamp the committee and waterlog it as it prepares to begin hearings after the November elections. But whether it meets this fate or not, the fact remains that back of the committee is a large array of economists, statisticians, legal lights and others who are assembling data to be used to diagnose American business in an effort to see if the economic system can be made to operate more efficiently.

For New Dealers insist it is not by any means hitting on all cylinders. And, whether or not the committee may, contrary to the insistence of its members, enter upon a witch hunt, it must be said that there does seem to be a truce at least on name calling. This was apparent long before the usual pre-election word went out from Hyde Park that there should be a halt on "economic saber-rattling," a thrust apparently directed at industry, despite the widespread impression that the Administration itself was extremely far in the lead in the epithetical contest. In any event the suggestion for no name calling has been widely approved with the hope that it will be transformed into reality, rather than a merely political emotional plea, seasonally made, only to be discarded after the polls are closed. Approval was given in a resolution by the Business Advisory Council, which took pains to urge Government and labor to ante their part of cooperation along with industry.

Arnold to Be Judge

In any case members of the National Economic Committee say they are receiving cooperation rather than bad names from business and they think this will contribute greatly toward solution of what they think are grave economic ills of the country. The committee of course can only recommend solutions. Legislation effectuating the so-called solution will rest with Congress. Assuming there is no longer the rubber-stamp type of Congress such as the country has witnessed for the past five years, the recommendations and legislation may well be two different things. Moreover, it is likely that even all of the recommendations of the majority of the committee may not get to Congress. For the purpose is to streamline the anti-trust laws and anything bearing on their revision undoubtedly will be carefully scrutinized by Thurman W. Arnold, trust buster member of the committee. Whether he turns thumbs down or thumbs up will be important and whatever he does may be expected to have White House approval, which is even more important.

On many things, however, there is no doubt that at least executive members of the committee—and probably some of its Congressional members—are in accord with the need to do something about problems the President mentioned in his anti-trust message. One of these is that—to quote the President—"of bringing idle men and idle money together." The President declared that the problem "will not be solved by abandoning the forward steps we have taken to adjust the burden of taxation more fairly and to attain social justice." So on this important point there is a prospective hitch at the outset of the monopoly inquiry between the Administration and industry. For industry definitely insists the Administration tax program already enacted and the further program it apparently has in mind—resumption of the plan to stick high taxes on profits—has much to do with the relationship between idle money and idle men.

New Deal Not to Blame

But the Administration staffs working up material for the monopoly inquiry naturally do not profess any New Deal culpability. The nearest approach in that direction which was meant to be confidential but found widespread publicity was the forthright document of former Assistant Secretary of State A. A. Berle, who took a crack at the New Deal's shotgun methods of regulation.

There is a thought in the Administration that, whatever its cause, the basic problem is why there are so many unemployed (11,000,000) and unemployed investment funds (estimated at about $47,000,000,000) and plant capacity way beyond what is being used. The unemployed lending funds in the banks consist of short time credits and long time capital funds. Some Administration sources say that no one has the answer but that a determined attempt will be made to shed light on the matter. They say, however, that there is a widespread feeling among "students of economics" that one reason for this situation is "the concentration of both industrial facilities and financial control."

Tying in with this view is the contention that big business controls prices. There arises, so it is claimed, "an inflexible price structure," or "rigid prices," as some prefer to say. Until recent reductions were made, steel prices were held up as a horrible example of this structure. Since then there has been a let up on harping against steel prices and copper now seems to be listed as price enemy No. 1.

But something has to be done about

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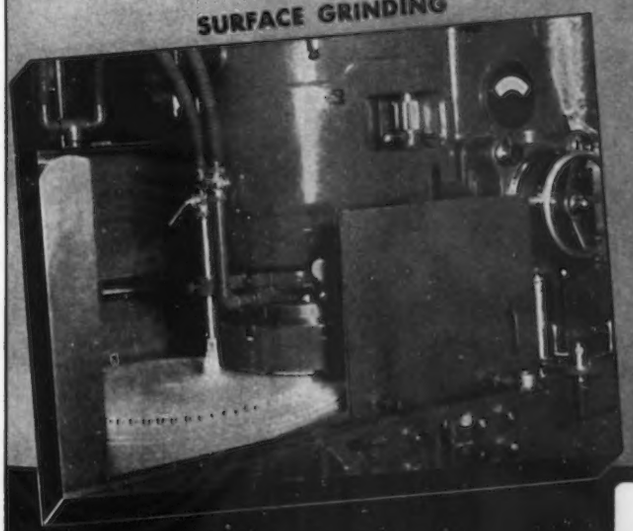

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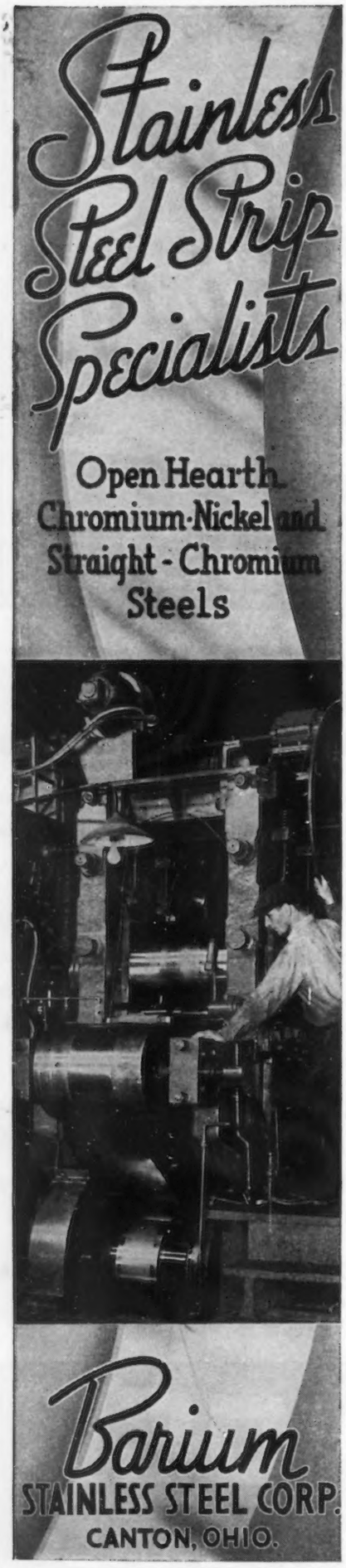
EMULSIFYING
CUTTING OIL



"rigidity of prices" and Administration economists say it must be done by Government regulation. They are vague about the form of regulation. Hints are given out of Federal licensing, so dear to the heart of Senator O'Mahoney, crusading chairman of the monopoly committee. But there are important members of the committee who clearly are not sold on the licensing idea. Control of price movements through monetary measures apparently has been shunted aside as impractical.

Claims that the New Deal is out to behead the capitalistic system are discredited. Instead of having this view—though there undoubtedly is a coterie of New Dealers who no doubt favor the guillotine for the profit system—the New Deal's dominant view is that private investment has to be depended upon for permanent recovery. Such leftish New Dealers as Harry Hopkins has, in effect, said as much, holding that Federal spending on a grand scale is justified but that private funds must come to the rescue if permanent recovery is to be achieved.

New Dealers generally share the Hopkins conception—with which industry generally differs sharply—"that competition on a scale that we have not known for many years is an absolute requirement without which the benefits of the Government's efforts are likely to be sapped away." Which is an adroit alibi for the failure of Government spending to bring about recovery and to pass the buck to private industry.

Monopoly To Blame

Nevertheless, that is the New Deal motif and it will be made distinctly clear at the monopoly investigation. For monopoly, so it is urged, is responsible for "rigidity" of prices and they are held up as damming recovery. So there must be some form of Government regulation to adjust prices to production and so on. At the same time there is less champing at the bit about big business and a tendency—temporary or otherwise—to ease such regulation whose workability or manner of operation still is a question that remains unanswered. It is even conceded that exercise of "financial control" may not be a bad thing, that it is not always necessarily "anti-social."

Steel has been cited by a prominent New Dealer to confirm this philosophy, which to some of the wilder brain trusters amounts to apostasy, showing that New Dealers often do not see eye to eye. And so it was said by this New Dealer, who may have been offside on this particular play, that exercise of financial control was a good thing in the settlement of the steel strike and that "evil potentialities" of such control were tempered by "divorcing from it the managerial function" as when steel prices were cut.

It yet remains to see just what form of Government regulation may be urged to "stabilize our economic system."

Northern Pacific Head Pleads for Wage Slash

WASHINGTON. — Recommending that it approve the proposed 15 per cent railroad wage cut, President Charles Donnelly of the Northern Pacific Railroad last week told the Presidential Emergency Board that under present conditions it is impossible for a railroad to expand or improve its property. Citing his own company as an example, Mr. Donnelly said that in 1929 it had 49,000 freight cars and now has only 39,000. Up to a short time ago, he said, it was possible to finance the purchase of equipment through equipment trusts, and on very favorable terms, by any railroad in such financial condition as to be able to make the initial payment of 25 per cent.

"The Northern Pacific, since 1934, has put out three of those trusts, to purchase 39 locomotives and 3000 new freight cars," said Mr. Donnelly. "We need very much to continue this program of equipment purchases. Under present conditions we cannot do so."

Martin's UAW Foes Restored to Jobs

WASHINGTON.—The internal dispute which has rocked the United Automobile Workers Union for months was apparently settled last week when the union's executive board accepted a decision by the arbiters, Philip Murray and Sidney Hillman, CIO vice-chairmen, and ordered the reinstatement of four union officials who had been discharged for alleged Communistic activities among other things.

Murray, SWOC chairman, and Hillman, chairman of the CIO's textile union, attributed the UAWU's internal disorders to its rapid growth and recommended that (1) the four discharged officials be reinstated and (2) that the organization immediately recognize "administrative responsibility and authority" by assigning specific duties to union officials.

New 1500-Mile Gas Line To Mesaba Range Planned

WASHINGTON. — Application has been filed with the Federal Power Commission by the Public Service Gas Co., a Montana corporation with principal offices in Minneapolis, for authority to construct a 1500-mile natural gas pipe line from Montana and Wyoming through North Dakota into South Dakota, Minnesota and Wisconsin at an estimated cost of $49,402,000. Like the proposed line of the Kansas Pipe Line & Gas Co., the Public Service line would be used on the Cuyuna and Mesaba ranges in northern Minnesota to beneficiate low-grade ore. The Public Service petition says governors and members of Congress from states which the lines would serve have endorsed the proposed line and requested that the Federal Government aid in financing it.

Sheet Plant Being Built in Greece

WASHINGTON.—A plant which will manufacture steel sheets of all kinds as well as tin plate is being built near Athens, Greece, according to a report to the Department of Commerce by the office of the American Commercial Attaché at Athens. The report says the plant is being built by the National Steel Industry, a company formed especially to manufacture sheets, etc., and that all of the shareholders were formerly connected with the steel sheet industry in the United States.

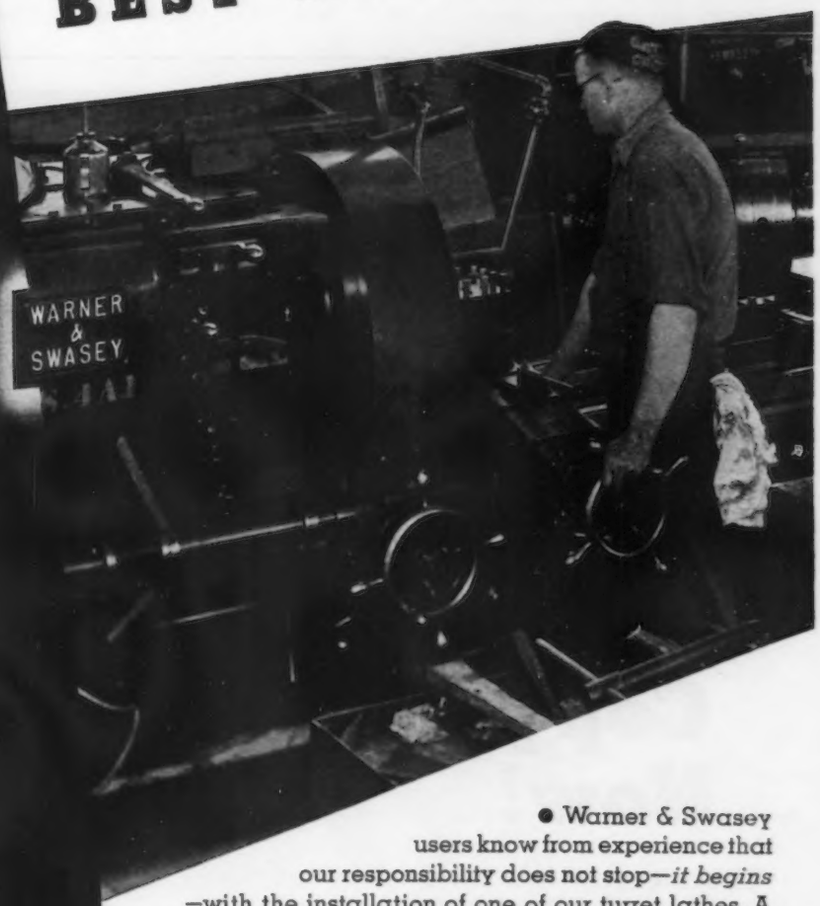
New York Shipbuilding Gets Naval Contracts

WASHINGTON.—Steel requirements for the destroyer tender Prairie and the seaplane tender Albermale for whose construction the New York Shipbuilding Corp. was awarded contracts, total 11,400 tons. The Prairie will call for 3700 tons of plates and 1700 tons of shapes. The Albermale will require 4000 tons of plates and 2000 tons of shapes.

Lessons in Arc Welding

A BOOKLET on "Practical Lessons In Arc Welding," 98 pages, is being issued by the Hobart Brothers Co., Troy, Ohio, price 50c. The text is from Part II of the company's larger volume, entitled "Arc Welding and How To Use It," and includes lessons on striking and manipulating the arc, welding with bare electrodes, welding and cutting with coated electrodes, and welding light gage steel.

CUSTOMERS ALWAYS MAKE THE BEST PROSPECTS



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Temporary Solution to Rail Wage Controversy Anticipated

WASHINGTON.—From the three-member railroad conciliation commission, appointed by President Roosevelt as the agency of last resort to negotiate an agreement between the railroads and the labor brotherhoods on the proposed 15 per cent wage cut, may come a temporary answer to the railroad problem.

After the wage controversy has been settled, President Roosevelt is generally expected to call in both the management and labor representatives in an effort to get them to draw up a railroad program for Congressional consideration. Mr. Roosevelt did precisely this two weeks ago and despite his statement at a press conference that the railroad representatives, meeting in another part of the White House at the time, had not discussed the contemplated wage cut, the representatives decided to call the whole thing off. Their reason was that nothing could be done until the wage issue had been decided.

But even though the proposed legislative program for the railroads was postponed by this action, it was regarded as significant that the White House had called in the management and labor representatives on the question. Congressional committees have studied the problem, bankers have submitted remedies, and so have Government commissions.

Evidence Deadline Oct. 17

The three-member commission, which is currently taking testimony from both labor and management, was called into the controversy after efforts of the National Mediation Board failed and after the railroad brotherhoods called a strike. Members of the emergency commission are Chief Justice Walter P. Stacy, of the North Carolina Supreme Court; Prof. Harry A. Millis of the University of Chicago, and Dean James E. Landis of Harvard Law School and former SEC chairman. They have ordered opposing sides to complete evidence and arguments by Oct. 17.

The commission must report to the White House by Oct. 17 and, although the President can ask both sides to accept its decision, the law does not require either side to do so. At any rate, another 30 days is given the two factions to study the board's findings, during which neither side can take steps against the other. After the 30 days elapse and if the recommendations of the Presidential commission are not accepted, the railroads can make effective the 15 per cent cut and the railroad brotherhoods are free to strike.

Presidents have named similar emergency boards on 10 other occasions, but in none of the other instances was a nation-wide strike or wage cut in the offing. In all but one case, however, recommendations by the emergency boards were accepted and put into effect by the affected parties.

Testimony being taken by the commission is largely a repetition of that heard ever since the controversy started. Representatives of the railroads point out that wages paid today are high in comparison with other in-

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dustries. Counsel for the brotherhoods deny this. Management says that the average railroad worker earned $1785 last year. The unions say they earned $1115; and both cite figures based on a study made by the Federal Railroad Retirement Board.

M. W. Clement, president of the Pennsylvania Railroad, testified last week that wage cuts were in the best interest of the men themselves. The railroad brotherhoods have grown powerful, he said, but "they do not seem to realize that with power comes responsibility and that in the way they meet that responsibility lies the welfare of the industry, and in that welfare lies the future of these employees."

J. & L. Offers Seamless Bell, Spigot Casing

WITH the initial shipment to users in the oil fields, the Jones & Laughlin Steel Corp., Pittsburgh, has added a seamless bell and spigot casing to its line of oil country products. This casing, made for welding in the well, features exclusively a die forged bell. This new type bell is formed by upsetting the casing instead of by the conventional expansion operation. This die forging operation forms a heavier bell wall, increases the effective welding area and assures a concentric correct diameter which by its uniformity makes possible easy stabbing and helps to maintain true alinement of the bell and spigot during welding. The new J & L bell and spigot casing will be available in sizes ranging from 5½-in. O. D., to 10¾-in., O. D., inclusive.

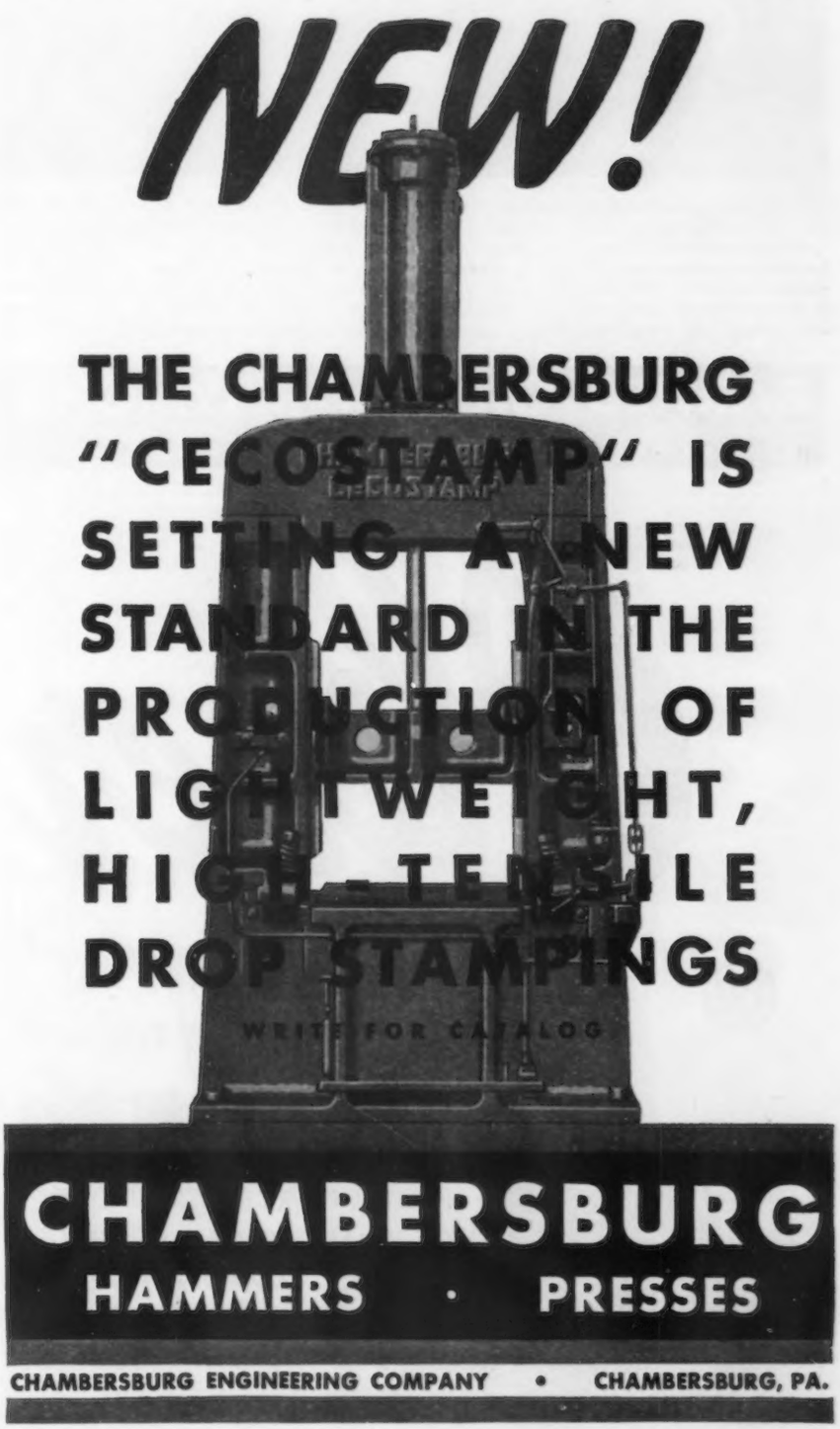
SAE Chooses Nominees For Next Year's Council

FOLLOWING are names of men nominated as officers and new members of the council of the Society of Automotive Engineers for 1939:

President, W. J. Davidson, general manager, diesel engine division, General Motors Corp.; treasurer, David Beecroft, Bendix products division, Bendix Aviation Corp.; councilors, W. E. McGraw, Chrysler Corp. of Canada, Ltd.; G. L. Neely, Standard Oil Co. of California; A. L. Beall, Wright Aeronautical Corp.; vice-presidents, William Littlewood, vice-president, American Airlines, Inc.; H. K. Cummings, chief, automotive power plants section, National Bureau of Standards; F. G. Shoemaker, chief engineer, Detroit diesel engine division, General Motors Corp.; A. G. Marshall, manager, technical applications, Shell Oil Co.; John G. Wood, assistant chief engineer, Chevrolet Motor division, General Motors Corp.; I. L. Carron, Dodge Brothers division of Chrysler Corp.; W. B. Hurley, Detroit Edison Co.; J. S. Erskine, International Harvester Co.; Harry O. Mathews, Public Utility Engineering & Service Corp.; and Carl J. Bock, Yellow Truck & Coach Mfg. Co.

U. S. Steel Medals To 84 Employees

UNITED STATES STEEL CORP. service medals were awarded 84 employees of the Tennessee Coal, Iron & Railroad Co. during the third quarter of 1938. J. S. Tollett, machinist in the mills department at Ensley Works, and Frank C. Baker, chief distribution clerk in the transportation department, led the list with 40 years' service each.



To the far corners of both B-G-R plants go the specification sheets of countless spring orders, to meet in the shipping room, formed in metal in an astonishing array of shapes and sizes. All along the way, there is never-ceasing vigilance, alert checking and testing—the sometimes "fussy" attention that gets things right. Hit-or-miss methods are not tolerated at B-G-R. We prefer the modern way—which gives you the advantages of up-to-date methods and materials—and springs of proven value. *Have your next orders for springs, wire forms and small stampings filled by B-G-R.*

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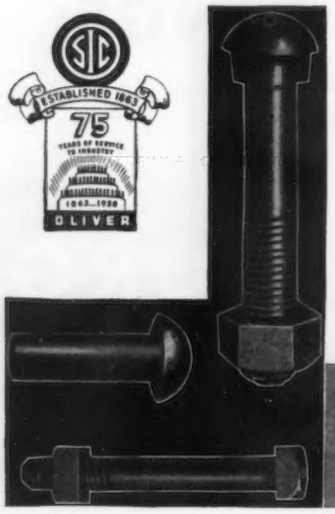

A GOOD BOLT AND NUT SPECIFICATION ANY TIME—ANY PLACE—FOR ANY JOB.

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100 Attend Founders' Society Convention

REAFFIRMATIONS of loyalty to the association and appreciation of its work provided the keynote of the fall meeting of the Steel Founders' Society of America, at Greenbrier Hotel, White Sulphur Springs, W. Va. Approximately 100 steel foundrymen attended.

Day before the convention started, the board of directors confirmed the election of F. M. Robbins, president, Ross-Meehan Foundries, Chattanooga, Tenn., to the presidency of the Society; approved a modest appropriation for a few initial advertisements; approved the list of occupational classifications recommended by a special committee; studied phases of the current situation with respect to the Federal Temporary Economic Committee and also the wage and hour law; and passed a resolution regarding the death of Frederick A. Lorenz, Jr., former vice-president American Steel Foundries, Chicago, and former Society president.

A.F.A. Groups Schedule Two Oct. Meetings

TWO more regional foundry conferences will be held in October under auspices of the American Foundrymen's Association and local foundrymen's groups at various technical schools in the Middle West. The meetings scheduled are as follows: Oct. 14 and 15, Quad City Chapter, Northern Illinois-Southern Wisconsin Chapter and Northern Iowa Foundrymen's Association, at the State University of Iowa; Oct. 27 to 29, Chicago Chapter, at Purdue University.

Porcelain Institute Meeting Postponed

THE eighth annual meeting and sales conference of the Porcelain Enamel Institute will be held in Cleveland, at the Hotel Statler, Nov. 16-17. This meeting had previously been announced for Oct. 25-26.

Steel Construction Institute to Move

AMERICAN INSTITUTE OF STEEL CONSTRUCTION has leased one-half of the 50th floor in the Architects' Building, 101 Park Avenue.

Chicago Products Convention Nov. 16-17

THE 10th annual Products' Exposition of the Purchasing Agents' Association of Chicago will be held at Hotel Sherman, Chicago, Nov. 16-17. The newest industrial products and services of members of the association and advertisers in *The Chicago Purchasor* magazine will be on display.

Founders' Society Offers Booklet on Steel Castings

A NEW 66-page book has been published by the Steel Founders' Society of America, Midland Bank Building, Cleveland, entitled, "The Design and Engineering Use of Steel Castings." Section 1 is titled, "An Engineering Approach to the Use of Steel Castings", by F. A. Lorenz, Jr. The second section of the book, "Steel Casting Design for the Engineer", by C. W. Briggs, R. A. Gazelius and A. R. Donaldson, was published by permission of the Navy Department.

W. J. Cameron Will Address Welding Society Meeting

THE annual banquet meeting of the American Welding Society at Detroit will be addressed by W. J. Cameron of the Ford Motor Co. on Thursday, Oct. 20. Harvey J. Campbell of the Detroit Board of Commerce will be the toastmaster. The banquet will be a high-light of the week's activities during the National Metal Congress. Tickets may be reserved through John D. Tebben of the P. R. Mallory Co., 2449 E. Grand Boulevard, Detroit, or by telephoning MAdison 0989.

15 Sewage Disposal Plants To Take 1600 Tons of Bars

PITTSBURGH.—Construction is to begin soon on 15 sewage disposal plants within a 100-mile radius of this district, involving the expenditure of $3,000,000 and requiring close to 1600 tons of concrete bars. The work is being carried on with PWA grants and is being supervised by the Chester Engineers, Clark Building, Pittsburgh. Plants are to be built at Bellefonte, Butler, Clarion, Penn Township, Sharon, Sharpsville, Uniontown, Torrance, Latrobe, Greensburg, Warren, Slippery Rock, Emlenton and Zelienople, all in Pennsylvania. The projects are in the process of being let to general contractors.

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One SPEED NUT takes the place of *both* threaded nut and lock washer. Only half as many parts to handle. Holds forever tight under firm spring tension. Prevents vibration loosening. Absorbs expansion and contraction caused by temperature changes in sheet metal. Prevents checking and crazing of porcelain surfaces. The harder the pull or strain, the firmer the SPEED NUT grips. Applied with amazing speed and ease. When used on rivets and plastic studs, they are actually "zipped" on.

The SPEED NUT system *cuts average net assembly costs 50%*. SPEED NUTS are manufactured of spring steel, cold rolled steel, phosphor bronze and stainless steel. Made for most standard sizes of machine screws, metal screws, metal rivets and plastic studs. Over 250 special shapes and sizes also developed for mass production products. Write today for samples, mentioning sizes you want and where you expect to use them.

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Home Building in U. S. Up 52 Per Cent in September

RESIDENTIAL building gained sharply in September, according to F. W. Dodge Corp. Contracts awarded last month for dwelling accommodations of all kinds in the 37 states east of the Rocky Mountains amounted to $99,574,000, compared with $65,590,000 in September, 1937, and with $99,732,000 in August of this year. The increase over September, 1937, was 52 per cent, and the daily average of September contracts was somewhat higher than the August daily average, whereas there is usually a seasonal decline in September.

Two outstanding large projects swelled the September residential total, both in New York City. One was the Red Hook housing project, first to be started under the new Federal public housing program, contracted for at $7,243,000. The other was the first unit of the vast investment housing project of the Metropolitan Life Insurance Co., valued at $11,685,000.

While these two projects were of exceptional character in the September record, both are forerunners of similar public and private housing projects to come. Together, they accounted for nearly $19,000,000 of the $34,000,000 increase over September, 1937. Of the 15 districts making up the 37 states territory, nine besides the metropolitan New York area showed residential contract increases over the corresponding period of last year. The month's record included 10,090 new single-family houses, compared with 8,373 contracted for during September, 1937.

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$33,596,000 Worth of Steel Used By WPA

STRUCTURAL and reinforcing steel valued at $33,596,000 were among the nearly $700,000,000 worth of materials purchased for projects of the Works Progress Administration during its first three years through June 30, 1938, according to statistics tabulated from United States Treasury and WPA sources. This is in addition to tools, excluding machine tools, of which $12,734,000 worth were bought and to the classification of "Other Iron and Steel Products," of which the purchases amounted to $35,227,000.

1938 Scrap Consumption About 18,400,000 Tons

DOMESTIC consumption of iron and steel scrap in 1938 is indicated at about 18,400,000 tons, of which 13,900,000 tons will be melted in open-hearth steel furnaces and 4,500,000 tons in blast furnaces and cupolas, it was estimated by Edwin C. Barringer, executive secretary of the Institute of Scrap Iron & Steel in an address at Boston. By comparison, the official Bureau of Mines calculation of scrap consumption in 1937 was 28,300,000 tons in steel furnaces and 9,600,000 tons in iron furnaces.

Influence of Cutting Fluids on Metal Cutting

(CONTINUED FROM PAGE 159)

lem. The one actually employed was loaned by Messrs. Germ Lubricants, Ltd. In Fig. 17 are plotted against each other the results obtained on this machine and the actual values of the tensions to draw down a mild steel 20 per cent with different lubricants. As will be seen, there is a distinct proportionality between the two sets of determinations. The apparatus can, therefore, differentiate between good, poor and medium lubricants readily, although it is not clear that it is safe to rely upon the measurements to distinguish between lubricants of closely similar properties.

The use of a copper coat in wet drawing is too well known to need more than mention here, though its more recent application in the drawing of such materials as the nickel-chromium alloys is of interest, but there is one other case of such a metallic coat being used to facilitate lubrication in wire drawing which possesses real interest. The introduction of the Dudzeele process in which a lead coating is employed where ordinary methods of lubrication have proved unsatisfactory, i.e. in the drawing of alloy steel, and copper nickel tubes and wire of the austenitic nickel-chromium steels, led to some work in this direction. It was shown that the function of the lead coat is mainly of a mechanical nature to facilitate the formation and retention of a stable soap film on the surface of the wire. With the heaviest reductions, and very heavy ones for this class of material were employed, the coated wires showed a remarkable combination of high tensile strength and ductility. Systematic work on other metallic coats might be well worth carrying out.

Flow in Drawing

Although a not inconsiderable amount of work has been done on the stress relationships in drawing from which, for instance, it has emerged that the shear stress required to produce flow is a linear function of the tensile strength of the material to be drawn down, and is a maximum at the point of entrance into the die, such considerations are not easily summarized. The only part of this work which will, therefore, be dealt with in this article is that in which the stream-line flow as given in the Hele-Shaw apparatus is applied to drawing problems. From this work points of very definite practical importance have come to light. The harmful effect of inclusions in the original rod upon both the life of the die and probably upon the properties of the wire need no stressing. The flow lines around a series of circular inclusions and the distortion of the streamlining are very apparent. In Fig. 18 are shown the resulting lines of equal velocity of flow. The extraordinarily irregular nature of the flow will be at once apparent, and the fact that this does no good to the wire readily appreciated. There is a further deduction which can be made. Even where the inclusion is some small distance below the surface of the metal, the flow lines are pressed together, indicating an increased pressure perpendicular to the die surface above them. It would appear, therefore, to be not impossible that the

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This is one of two new model, 6-ton, Diesel-powered Whitcomb Locomotives recently shipped to Dutch Guiana Mines in the heart of the jungles. The track system for this operation is of necessity very temporary in nature. The heat and humidity reaches a point seldom, if ever, experienced in the United States. Notwithstanding the unusual conditions, these locomotives will be manned by natives, which is a tribute to Whitcomb simplicity and dependability. Whitcomb Locomotives of 18-ton capacity will be used to haul ore to the mill.

For over 65 years, Whitcomb Locomotives have been doing tough haulage jobs efficiently and economically. Find out how Whitcomb haulage will save you expense. Let our engineers survey your needs and make recommendations without obligation.

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The Ridge Tool Co., Elyria, Ohio

RIDGID PIPE TOOLS

excessive wear of the die due to inclusions in the metal being drawn may not be due solely to the scratching of the die surface by the hard inclusions themselves, but may also result from the increased local pressure due to the presence of inclusions which never actually come into contact with the die at all.

The author's acknowledgments must be made to E. L. Francis, who for many years worked with him on wire drawing problems and from whose own papers a not inconsiderable amount of the material used for this article has been taken. It seemed better to confine attention to a summary of the work done in the author's own department rather than attempt a general critical survey of the whole of wire drawing research, for the latter would, of course, require considerably more space than is available herein at the present time.

Low-Temperature Silver Brazing Alloys

(CONTINUED FROM PAGE 169)

atures, the time necessary for making joints is greatly reduced and there is a big saving in the amount of gas or electric power used.

Cleaning time is cut to a minimum, as little of the brazing alloy is used. It is not necessary to grind off masses of welding rod in order to get neat appearance. Only a fine line of silver brazing alloy shows on a well made joint and no finishing is necessary unless, of course, a polished surface is required, and even then surface discoloration need only be removed as the flux used with these alloys affords excellent metal protection.

Few other methods of joining metals have so many advantages as the low temperature brazing process. Everything considered, this process gives joints which are inclusively strong, ductile, leakproof, highly conductive to electric flow, corrosion resistant and economical, giving protection to the metals and producing joints of clean appearance.

These low temperature silver brazing alloys have tremendous possibilities for wider industrial use and this resume has only high spotted some of the more conspicuous and familiarly known applications. The uses of these alloys cover practically every type of equipment manufactured.

Japan to Operate China's Best Iron Mine

TOKYO (*By mail*). — China's greatest iron mine, the Tayeh mine near Hankow, will be turned over to the Japan Iron Mfg. Co. as soon as the Hankow district is under Japanese control, it has been announced.

It is explained that Japan has been the sole creditor of the operating concern, the Hanyehping Coal & Iron Co. The Japan Iron Mfg. Co. has advanced 40,000,000 yen secured by a mortgage on the mine. There has been no payment of either capital or interest, the Japan Iron Mfg. Co. claims. It is asserted that interest and principal now amount to 70,000,000 yen.

Tayeh ore is said to have a purity of 55 to 60 per cent iron, and the deposit is estimated at 50,000,000 tons. Output in 1933 reached 366,000 tons, but declined in subsequent years.

Germany to Build Iran Steel Plant

LONDON (*By mail*).—An order, valued at about 30,000,000 marks, for the erection and equipment of an iron and steel plant in Iran has been placed with German concerns by the government of Iran.

Construction Activity Holds Above 1937 Level

HEAVY engineering construction awards in September totaled $289,725,000, the highest for any September since 1929, according to a compilation by *Engineering News-Record*. This total compares with $236,271,000 in the preceding month and $210,511,000 in September, a year ago. The average weekly volume of awards in September was $57,945,000, a decline of 2 per cent from the August figure, but 38 per cent above the total for September, 1937. The aggregate volume for the first nine months of the present year was $2,004,260,000, a gain of 6.3 per cent over the corresponding period of 1937 and the highest of any like period since 1930.

The bulk of the gain, both in the monthly and the nine-month figures, was due to the continually expanding volume of public construction activity. The September total for this type of work, $236,283,000, was the highest of any month since January, 1936. On the other hand, the volume of private construction awards in September, at $53,442,000, showed a decline of 15 per cent from the August figure and 37 per cent from September, 1937.

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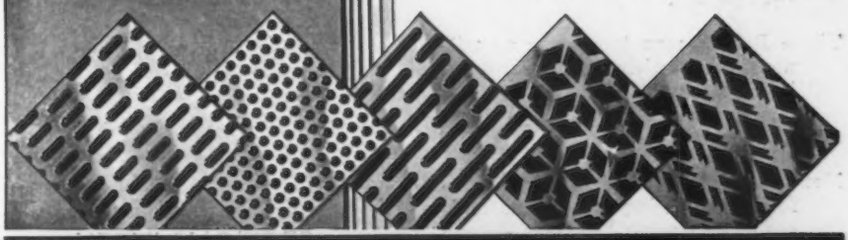

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THE AMERICAN WELDING & MFG. CO.

WARREN OHIO

"If It's Round We Can Make It"

. . . THE NEWS IN BRIEF . . .

Tool Engineers gather in Pittsburgh in convention.—**Page 275.**

Automobile production rises sharply. . . . Flood of retail orders greets announcements of new models. . . Ford announces a new Mercury Eight.—**Page 276.**

September steel ingot output highest in eleven months.—**Page 279.**

Tractor price reductions of $30 to $140 are announced by large manufacturers, effective immediately. —**Page 279.**

Three Detroit men to appear as witnesses in anti-trust suit brought by Department of Justice against Aluminum Co. of America.—**Page 279.**

Monopoly Committee deluged with information as inquiry into nation's economic system broadens.—**Page 280.**

Four United Automobile Workers Union officials, discharged by Homer Martin, union president, for alleged Communistic activities, have been restored to their posts.—**Page 282.**

New 1500-mile gas line, costing $49,402,000, to run from Montana and Wyoming to the Cuyuna and Mesaba ranges in northern Minnesota is planned by the Public Service Gas Co., Minneapolis.—**Page 283.**

Plant to manufacture steel sheets is being built near Athens, Greece, by the National Steel Industry.—**Page 283.**

Contracts for two naval vessels, involving 11,400 tons of steel, awarded to New York Shipbuilding Co.—**Page 283.**

Temporary solution to railroads' problems hoped for with President expected to call on labor, management representatives for Congressional rail program.—**Page 284.**

Jones & Laughlin Steel Corp. adds seamless bell and spigot casing to its line of oil-country products.—**Page 285.**

United States Steel Corp. awards service medals to 84 employees of Tennessee Coal, Iron & Railroad Co.—**Page 285.**

Society of Automotive Engineers nominate officers and new members of its council for 1939.—**Page 285.**

One hundred attend Founders' Society convention.—**Page 286.**

Eighth annual meeting of the Porcelain Enamel Institute has been postponed from Oct. 25-26 to Nov. 16-17.—**Page 286.**

Two more regional foundry conferences will be held in October, one at University of Ohio, another at Purdue University.—**Page 286.**

American Institute of Steel Construction has leased one-half of the fiftieth floor in the Architects' Building, 101 Park Avenue, New York.—**Page 286.**

Founders' Society offers booklet on steel castings.—**Page 287.**

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MEETINGS

Oct. 12 to 14—Porcelain Enamel Institute, University of Illinois, Urbana, Ill.

Oct. 12 to 15—The Electrochemical Society, Rochester, N. Y.

Oct. 13 to 15—Society of Automotive Engineers, aircraft production meeting, Los Angeles.

Oct. 14 to 15—American Society of Tool Engineers, Pittsburgh.

Oct. 17 to 21—National Metals Congress, Detroit.

Oct. 21—Foundry Equipment Manufacturers Association, Cleveland.

Oct. 21 to 22—Industrial Unit Heat Association, French Lick, Ind.

Nov. 14—Society of Automotive Engineers, annual dinner, New York.

Fifteen sewage disposal plants, involving $3,000,000, to be built in Pittsburgh area.—**Page 287.**

American Welding Society to hear address by W. J. Cameron, of Ford Motor Co., at banquet during National Metal Congress at Detroit. —**Page 287.**

Chicago Association of Purchasing Agents will hold its tenth annual exposition Nov. 16-17 at Hotel Sherman, Chicago.—**Page 287.**

Third quarter orders received by General Electric Co. ran 31 per cent below sales in the like 1937 period.

Contracts for residential building in 37 states of United States rose 52 per cent in September to total of $99,574,000.—**Page 288.**

Structural and reinforcing steel valued at $33,596,000 is purchased by the WPA during its first three years of operation.—**Page 288.**

Consumption of iron and steel scrap in the United States in 1938 is estimated at 18,400,000 tons.—**Page 288.**

Railroads can't expand or improve their properties in 1939 unless able to save through wage reductions, Charles Donnelly, president, Northern Pacific Railroad, says.—**Page 289.**

September's heavy engineering awards totaled $289,725,000, the highest for any September since 1929.—**Page 291.**

Japan to operate China's best iron mine.—**Page 291.**

German interests to build steel plant in Iran.—**Page 291.**

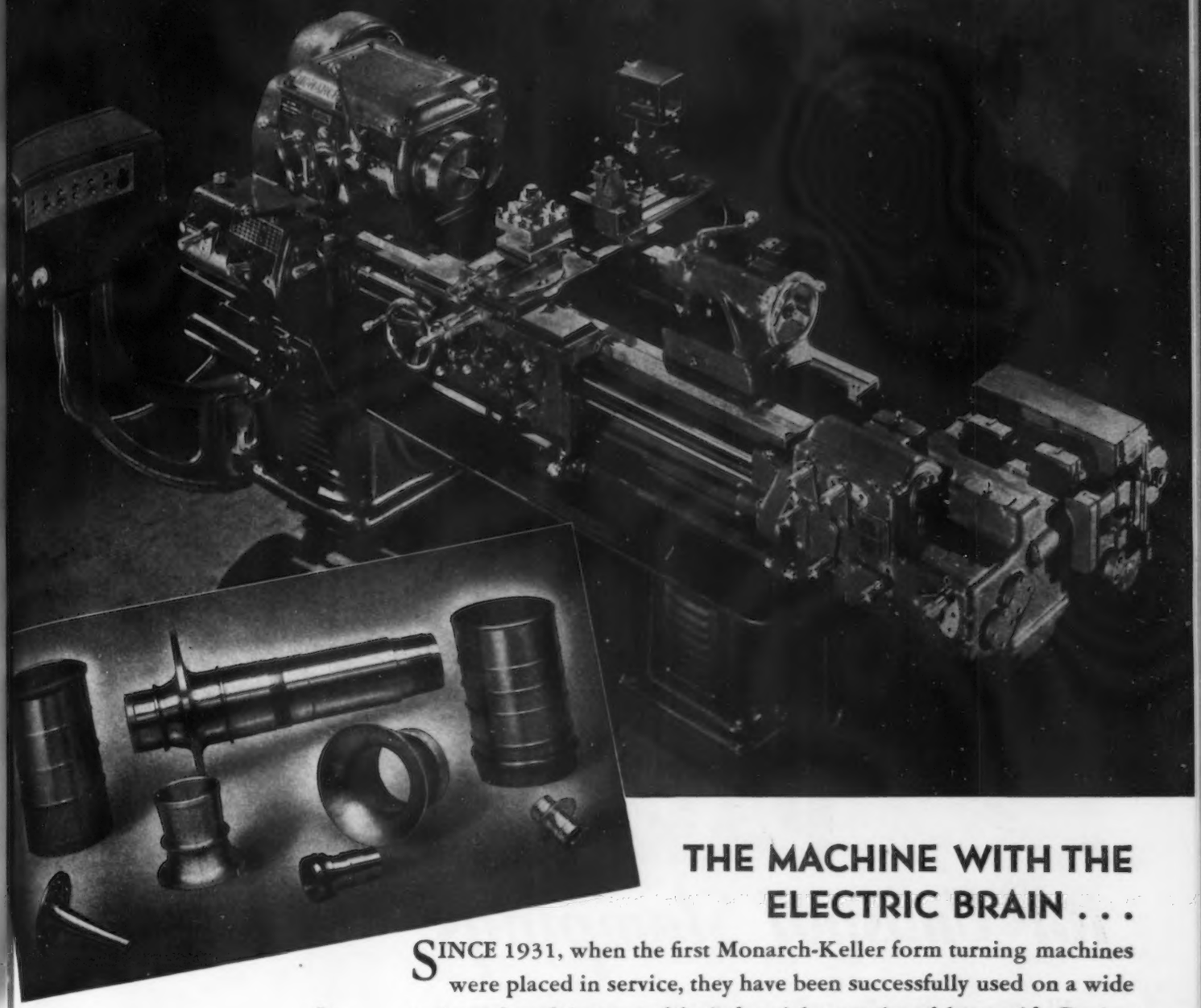
Kelsey-Hayes Wheel Co. abandons plans for Pittsburgh plant, cites steel basing point revisions as factor.—**Page 299.**

A. G. Bryant is reelected president of the Associated Machine Tool Dealers of America.—**Page 302.**

Republic Steel Corp. blows in its new 1000-ton blast furnace at Youngstown.—**Page 302.**

United States Steel Corp. subsidiary shipments of finished steel products in September totaled 577,666 tons.—**Page 303.**

MONARCH KELLER



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This illustration shows a group of aircraft engine parts produced on a Monarch-Keller machine through the use of thin metal templates. These parts are held to extreme accuracy limits by the Monarch-Keller method of machining.

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. . . PERSONALS . . .

E. M. FIEGER and J. K. DEVITT have been appointed construction engineer and chief civil engineer, respectively, of Gary works of Carnegie-Illinois Steel Corp. Mr. Fieger was the construction engineer of the new Irvin works at Clairton, Pa., and Mr. Devitt the former assistant chief civil engineer at Gary.

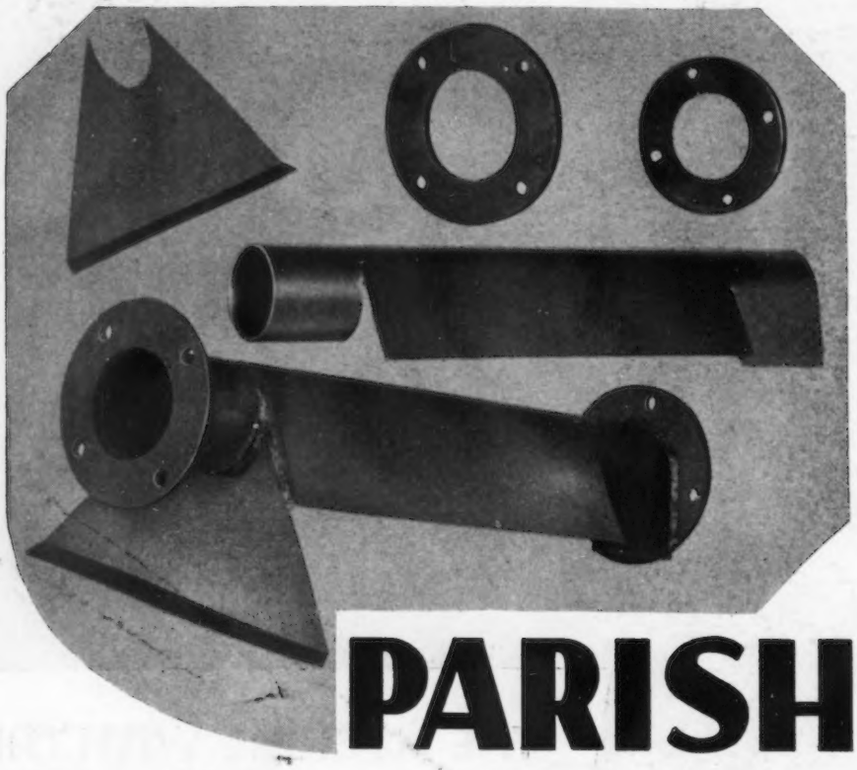
Mr. Fieger began his service with United States Steel Corp. subsidiaries in 1903 as a mechanical draftsman with the former American Sheet & Tin Plate Co., Pittsburgh. In 1905 he became assistant to the chief engineer and four years later was sent to Gary to oversee the initial construction of the Gary sheet mill of the same company. Becoming civil engineer and construction engineer in 1910, he supervised the construction of the first and second units of the Gary tin mill and was active in the installation of the 42-in. hot strip mill there. This

E. M. FIEGER

was the first mill of its kind in the plants of the corporation subsidiaries. When the American Sheet & Tin Plate Co. became part of Carnegie-Illinois in 1936, Mr. Fieger remained in the civil engineering department in Pittsburgh until 1937, when he was appointed construction engineer of the new Irvin works, the position he has held until the present time.

Mr. Devitt began his association with the steel industry as an engineer with the Shenango Furnace Co. in 1906. He remained with this company

J. K. DEVITT



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E. R. RATH

until April 1, 1910, when he became a civil engineer at Gary works. In 1916 he was appointed assistant chief civil engineer and served in that capacity until his recent appointment.

❖ ❖ ❖

EDWIN R. RATH, for the past four years head of the department of industrial research of the University of New Hampshire, has joined the staff of the Power Transmission Council, Inc., Boston, as senior engineer. He was graduated from the University of Pittsburgh in 1921 and has been engaged in educational work and with commercial firms on sales development.

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KIRKE W. CONNOR, president of the Micromatic Hone Corp., Detroit, sailed Oct. 6 on a European business trip on which he will present technical papers before seven foreign engineering societies. The papers are of a broad informative nature, principally on subjects related to the processing of bores. In recent months Mr. Connor has presented two similar papers in the United States. One, "Processing Cylinder Bores," was read before the Detroit chapter of the American Society of Tool Engineers, the other, "Surface Finish Related to Wear in

HERBERT L. GRAY, whose appointment as assistant vice-president of the Weirton Steel Co., in charge of Western sales, was announced in these columns last week.

For gas or oil fired heat-treating or melting furnaces or in controlled atmosphere units, ROOTS-CONNERSVILLE Rotary Positive Blowers, or Gas Pumps assure the delivery of that necessary volume of air or gas for best combustion. Steel treaters who have used them through several decades purchase Roots-Connersville when they want dependable results. There is a size to economically serve a small laboratory unit or the largest production furnace.

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ST. LOUIS
LOS ANGELES

Internal Combustion Engines," was presented at the National Tractor meeting of the Society of Automotive Engineers in Milwaukee last spring.

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DAVID E. ANDERSON has resigned as chief engineer of the Bohn Aluminum & Brass Corp. of Detroit.

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C. N. KIRKPATRICK, secretary and sales manager of Landis Machine Co., Inc., Waynesboro, Pa., sailed Oct. 8 to visit the company's representatives in England and on the Continent.

❖ ❖ ❖

C. T. GEUTHING, former sales engineer at the main office of the Heald Machine Co., Worcester, Mass., will take charge of the Detroit sales office of the Heald company, effective Nov. 1. ROBERT M. LIPPARD, until now manager of the Detroit office, will return to duties in the home office.

❖ ❖ ❖

DEAN H. MITCHELL, a former nightshift man in the tin mill at Gary works of Carnegie-Illinois Steel Corp., recently was elected president of the Northern Indiana Public Service Co., largest public utility in that State. Mr. Mitchell, who has spent his entire business life in the Calumet region of Chicago, started work at the mills on the 13½-hr., 7-day a week nightshift just before the World War. He became an ensign in the Navy during the War, returning after the Armistice as assistant store keeper. He was soon made nightshift store keeper at the mill and before long was transferred to the accounting department of the American Sheet & Tin Plate Co., leaving in 1924 to become assistant auditor of the Calumet Gas & Electric Co., one of the properties absorbed in the present utility system which he heads.

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V. J. HYDAR, director of employment of the Falk Corp., Milwaukee, who is credited with the distinction of having formulated and put into effect one of the first systems of apprenticeship training in America, has resigned to accept appointment as senior field representative of the Federal Committee on Apprenticeship Training. His work will consist of contacting employer and labor groups to promote the adoption of national standards for apprenticeship in the metal trades industries.

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IRVINE, WARREN COUNTY, PENNA., U. S. A.

BERT L. WOOD, formerly of the Carnegie-Illinois Steel Corp., who has become engineer in charge of a new program of the American Iron and Steel Institute to promote broader use of light steel construction in buildings.

WALLACE K. BROWN, who has been identified with the Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., since his graduation from the University of Illinois, has been appointed vice-president and general sales manager. B. D. CHRISTIAN, vice-president and formerly general sales manager, will continue in an administrative capacity.

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MARCUS A. GROSSMANN, director of research, Carnegie-Illinois Steel Corp., was scheduled to discuss "Hardenability of Steel" at the monthly meeting of the Notre Dame chapter of the American Society for Metals on Oct. 12.

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RAYMOND LOEWY, industrial designer, returned to this country on Oct. 10. During his sojourn the French government awarded him a gold medal for his contributions to American transportation design as represented by new railroad equipment shown at the Paris Exposition.

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L. H. SCHEIFELE, formerly metallurgist and tool supervisor for the Reading Co. and Central Railroad Co.

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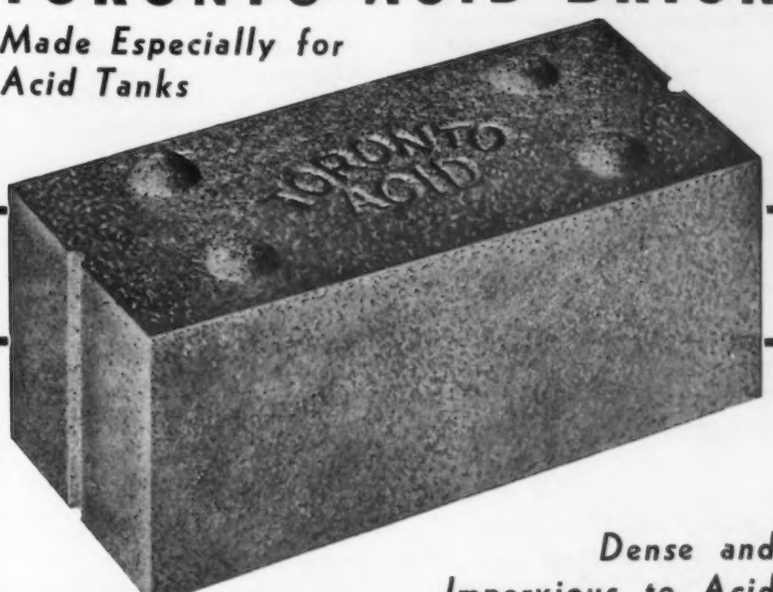

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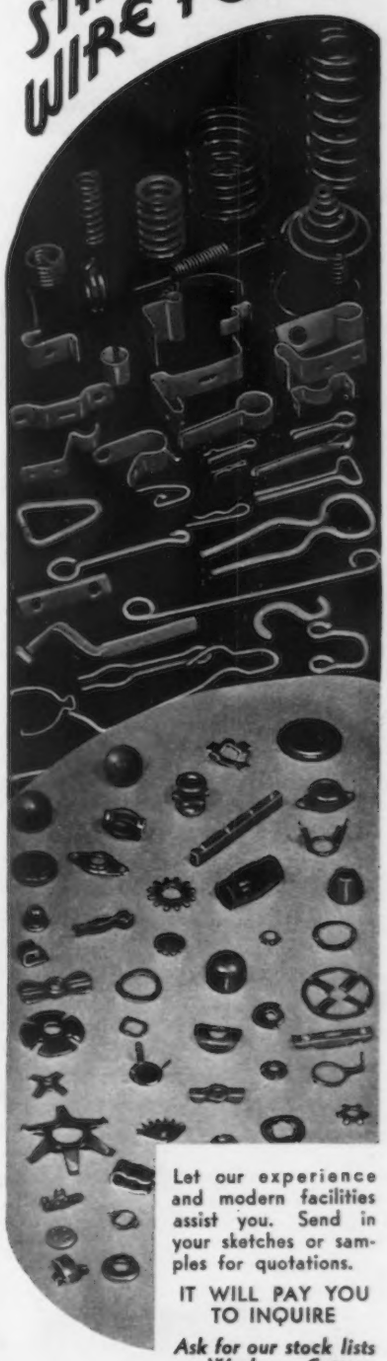

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of New Jersey, has been appointed engineer of tests of the Reading Co., succeeding the late J. B. Young. Mr. Scheifele is an active member of the American Society for Metals, having acted as secretary-treasurer of the Lehigh Valley chapter for several years.

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JOHN T. BROWN, vice-president of the Chain Belt Co., Milwaukee, has been elected to the board of directors. FRED V. GARDNER, who has been connected with the company since early in the year in a consulting capacity, has been made acting treasurer. He was formerly associated with the General Electric Co., Schenectady, as supervisor of budgets.

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HARVEY NICHOLSON, a graduate of the Missouri School of Mines and Metallurgy, Rolla, Mo., has been added to the laboratory staff of the Stearns Magnetic Mfg. Co., Milwaukee.

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ARMOUR D. WILCOX, JR., has ended his 10-year association with Pittsburgh Steel Co.'s industrial advertising department to become president of Allied Display Crafts, Pittsburgh, designer and builder of industrial and commercial displays and exhibits.

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W. A. MAXWELL, JR., heretofore vice-president of the Colorado Fuel & Iron Corp., Denver, has been elected president, succeeding ARTHUR ROEDER, who had held that post since 1929. Mr.

W. A. MAXWELL, JR.

Maxwell joined the company in 1927. Previously he had been general superintendent of Inland Steel Co., Chicago. He is a graduate of Pennsylvania State College.

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FRANK J. CARR, who has been assistant to the president of American Steel & Wire Co., United States Steel Corp. subsidiary, has been appointed comptroller of the company. Previous to joining American Steel & Wire last March, Mr. Carr had for four years been comptroller of the Tennessee Valley Authority at Knoxville, Tenn., and before that had held a similar position with the Hahn Department Stores and Aviation Corp. and subsidiaries.

Mr. Carr is well known in accounting circles, having been one of the organizers and first president of the Controllers' Institute of America. He is also a member of the Society for the Advancement of Management and the Cosmos Club of Washington, D. C.

Born in Batavia, Ill., in 1892, Mr. Carr attended school there and in Aurora, Ill., before going to Wharton School of Finance at the University

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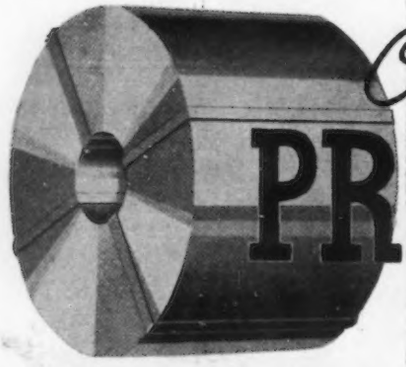

Cold Rolled
PRECISION
STRIP STEEL

of Pennsylvania. He was graduated in 1915 with a degree of B.S. in Economics. Mr. Carr served as lieutenant in the Ordnance Department of the Army during the World War.

❖ ❖ ❖

BENJAMIN SCHWARTZ, vice-president of Schiavone-Bonomo Corp., New York, gave a lecture on scrap Oct. 10 to students in classes on raw materials and export trade of the School of Commerce of New York University. He has been invited to address economic seminars at various universities including Cornell, Pennsylvania, Wellesley and other institutions on the subject of scrap.

. . . OBITUARY . . .

MICHAEL F. BARRETT, founder and president, Cleveland Brass Mfg. Co., died Oct. 6 at his home in Cleveland. He founded the company in 1892.

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JOHN E. FIELDS was buried Oct. 6 in Fargo, N. D. Mr. Fields, attached to the manufacturing division of the Chrysler Jefferson Avenue plant in Detroit for the last 10 years, died of a heart attack. He was 64 years old. Mr. Fields was a brother of Joseph E. Fields, executive vice-president of Chrysler Corp.

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FRANK A. HOSMER was buried Oct. 3 in Detroit. Born April 11, 1861, Mr. Hosmer was for many years associated with the Michigan Central Railroad and later helped organize the G. A. Hosmer Lubricant Co., Buffalo. He retired 25 years ago.

❖ ❖ ❖

RICHARD KHUEN, JR., retired chief engineer of the American Bridge Co., died Sept. 24 at Pittsburgh. Mr. Khuen, nationally known bridge engineer, had managed the building of Hell's Gate bridge in the New York harbor and various bridges in the San Francisco harbor.

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CHARLES A. CAHILL, SR., Milwaukee, prominent consulting engineer in the steam power plant field, died on Oct. 5, aged 77 years. He was born in Fitzwilliam, N. H., and served his apprenticeship from 1879 to 1884 in the Harris Engine Works, Providence, R. I. In 1898 he was chief engineer of the Sioux City Traction Co., Sioux City, Iowa, later becoming chief engineer of power plants of the Milwaukee Electric Railway & Light Co. In 1927 he formed the consulting engineering firm of Charles A. Cahill & Sons, Milwaukee, with his sons, Ralph H., now village commissioner of Whitefish Bay (Milwaukee), and Charles A., Jr., chief engineer of the Galland-Henning Mfg. Co., Milwaukee.

Kelsey-Hayes Drops Pittsburgh Project

PITTSBURGH. — Kelsey-Hayes Wheel Co., Detroit, automobile parts maker, has abandoned plans for a factory on Neville Island near Pittsburgh, according to a letter from company officials to Neville Township officers. The change in the basing points of steel, since the plan was first proposed, was given as a reason by Kelsey-Hayes company for abandoning the project.

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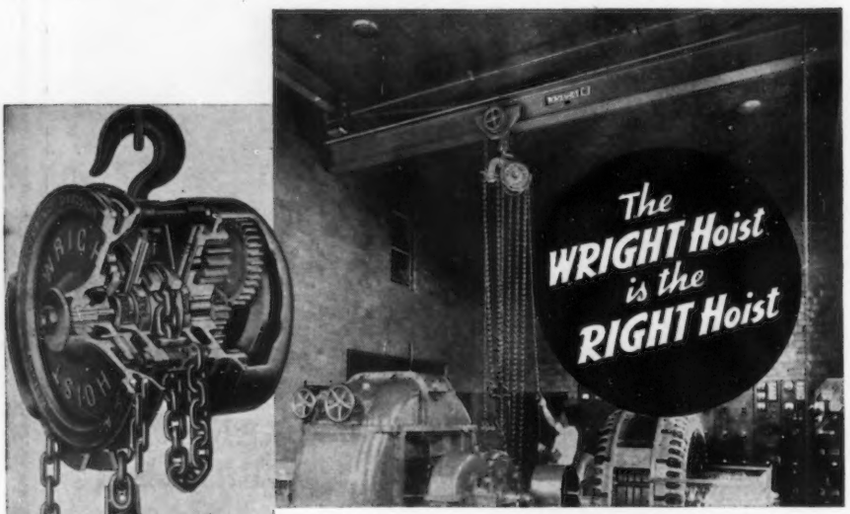
Briggs Strike Opens UAW Fight for 32-hr. Week in Auto Plants

DETROIT.—Reunited again in the battle with the automotive industry, officers of the United Automobile Workers union began what looked like a long drawn out battle to attain the 32-hr. work week. Fifteen thousand employees of the Briggs Mfg. Co. and the Plymouth division of Chrysler Corp. returned to work Monday morning after being idle last Friday when union members at the Plymouth plant refused to work more than four days.

On Tuesday morning negotiations were begun between Herman Weckler, Chrysler vice-president in charge of industrial relations; Morris Field, a union executive board member representing Homer Martin, president, and R. J. Thomas, UAW vice-president in charge of locals; Richard T. Frankensteen, recently reinstated vice-president, and Leo Le Motte, president of the Plymouth local also were on the union committee.

Similar arguments pend with the General Motors Corp., particularly between the Flint local and the Buick division.

Under the terms of the unions' contract with Chrysler, employees laid off more than 12 months lose their seniority ratings and have no more status than a new employee, Martin declared. He said that thousands had been laid off since last November and faced loss of any claim on their jobs.



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WRIGHT *Improved High Speed* **HOISTS**

Social Security Laws Here to Stay, Girdler Declares

SOCIAL security laws and social security taxes now in effect in the United States never will be removed, Tom M. Girdler said this week in an address at Chicago.

"There can be no question about the soundness of the principle of social security but what is urgently needed today is a more practical application of that principle than is provided in the present laws," the president of the American Iron and Steel Institute said.

"Beyond the laws now in effect," Mr. Girdler added, "there are some crack-pot schemes, all of which are manifestations of the desire for security implanted in the human heart."

It is now possible to see signs of improvement in the months ahead, and if out of the event which stopped another world war, there should come a period of peace, the way would be opened for a revival of world commerce, the institute president said. Declaring that the steel industry has demonstrated its sense of social obligation, Mr. Girdler said that since 1895 steel wage rates have increased 425 per cent, the work week has declined to 40 hr. from 67 hr. and collective bargaining has been established throughout the industry.

Differentials Snag Steel Wage Ruling

WASHINGTON. — The question of wage differentials for small plants apparently continued this week to be the reason for the Public Contracts Board's delay in making minimum wage recommendations in the steel industry as the pending steel wage case went into its twelfth week since public hearings were held.

Board members declined comment but the question of differentials appeared to be deferring the final recommendations just as it did several weeks ago. To get around this difficulty, it is believed that one of two possible courses will be followed by the board:

(1) The agency could recommend wage differentials for smaller units; or (2) it could point out in the recommendations that small units were eligible to apply for wage differentials if the prescribed minimum rate was found to impose a hardship.

. . . PIPE LINES . . .

Napa, Calif., has awarded 4530 ft. of 24-in. pipe to California Corrugated Culvert Co., Berkeley, Cal., through contractor.

Bureau of Reclamation, Denver, has opened bids on 2,000,000 ft. of 1-in. O. D. black pipe, 4,000 180-deg. bends, and 11,000 90-deg. bends (Invitation 38159-A).

Sacramento, Cal., has opened bids on 1150 ft. of 20-in. and 6280 ft. of 18-in. steel pipe.

Wood Engineering & Construction Co., Tyler, Tex., has authorized new welded steel pipe line from gas field district at Chapel Hill, Tex., to point near Wright City, Tex., about 16 miles, for natural gas transmission. Connection will be made with main pipe line system at last noted place. Cost close to $100,000 with booster station and operating facilities.

Andrews, Tex., plans pipe lines for natural gas distribution, including main welded steel pipe line to gas field area, about 11 miles from municipality, from which supply will be secured. Main supply line will connect with control station to be built at city limits. Cost about $60,800. Financing is being arranged through Federal aid. Joseph E. Ward, Harvey-Snider Building, Wichita Falls, Tex., is consulting engineer.

Chino, Cal., plans about 5280 ft. of 12-in., and 2640 ft. of 4-in., welded steel pipe, both 10-gage, for extensions in main water supply line. Bids will be asked soon. Cost about $30,475 with new reinforced-concrete reservoir. Financing has been arranged through bond issue and Federal aid. R. V. Ward, Upland, Cal., is consulting engineer.

Clovis, N. M., plans pipe lines for natural gas distribution system, including main welded steel pipe line for connection with transmission line for supply, control station and other operating facilities. Cost about $150,000. Financing is being arranged through Federal aid. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

Charlottesville, Va., has authorized pipe lines for extensions and replacements in gas distributing system and will proceed with work at once. Fund of $37,600 has been arranged through Federal aid.

Metropolitan Utilities District, 18th and Harney Streets, Omaha, Neb., Col. T. A. Leisen, secretary, plans pipe lines for gas distributing systems in Districts Nos. 856, 857 and 858, recently created.

. GREAT BRITAIN .

. . . *Export revival still clouded by political uncertainty*

LONDON, Oct. 11 (By cable).—There is a momentary improvement in the Continental iron and steel market. Producers are hoping that the export revival will be maintained but the outlook is clouded by political uncertainties. Sellers are less inclined to make price concessions, but to combat United States competition reductions were made in sales to South Africa and Norway on bars, shapes and plates.

Business in Great Britain is still restricted. Consumers are working off stocks and are not likely to purchase on a large scale this year. Steel works are operating at about 50 per cent.

A committee of motor car manufacturers is negotiating with the Steel Federation on 1939 steel prices.

Pig iron demand has now subsided.

Home air raid precaution and defense are still calling for good orders of black and galvanized sheets. Shipbuilding is still poor. There is some export demand for black sheets, otherwise the export market is quiet.

Following orders in the crisis week, unfilled tin plate orders are now over 2,250,000 base boxes. The demand is still quite good, though not as strong as two weeks ago. The main interests are the Continent and Empire markets, with good demand from South America.

Weirton Arguments Postponed to Oct. 19

WASHINGTON.—The National Labor Relations Board has announced further postponement till Oct. 19 of arguments in the Weirton Steel Co. case. The postponement was decided upon by agreement of both sides.

KINNEAR *Rolling Doors*

They go OUT OF THE WAY to cut door costs

And that's exactly what Kinnear Rolling Doors do! Coiling compactly above the opening, they save valuable, **usable** floor and wall space. They save time and labor costs by raising conveniently over ground obstructions — and by being counterbalanced for smooth, easy, rapid operation. And they cut maintenance costs in a number of ways! Rugged all-steel construction in itself means extra years of dependable service! But in addition, Kinnear Rolling Doors will not sag, warp or pull apart . . . and they give extra protection against fire. They are built throughout to withstand all the common hazards.* These and many other savings — plus the fact that every Kinnear Door is custom built for easy, economical installation in the particular opening for which it is intended — make Kinnear Rolling Doors outstanding in door economy!

When equipped for motor control, Kinnear Rolling Doors can be opened or closed at the mere touch of a button—from any number of convenient points! Kinnear Motor-Operated Rolling Doors are the last word in door efficiency and economy!

* In case of accidental damage, all Kinnear Door parts are always available, and can be easily and economically replaced. An added benefit made possible by Kinnear's reliable, nationwide organization!

THE KINNEAR MFG. CO.
1760-80 FIELDS AVE. COLUMBUS, OHIO

Bryant Again President Of Machine Tool Dealers

CINCINNATI.—A. G. Bryant, president, Bryant Machinery & Engineering Co., Chicago, has been re-elected president of the Associated Machine Tool Dealers of America at the annual meeting of the association held at Hotel Alms, Cincinnati. Another Chicagoan elected to office is E. P. Essley, E. L. Essley Machinery Co., chosen as secretary and treasurer.

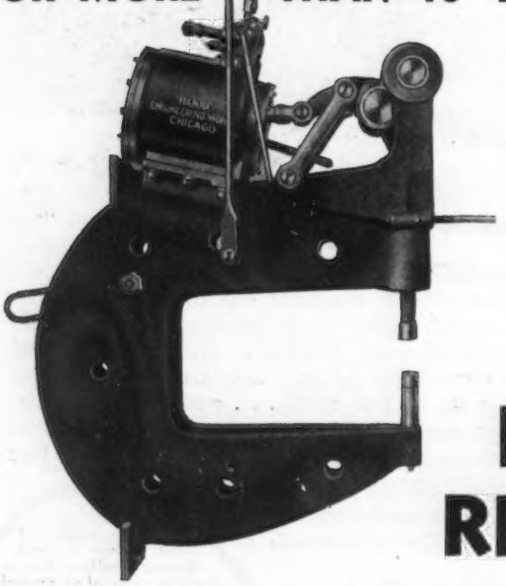
The association represents the organized distributers of machine tools throughout the United States, with sales of $100,000,000 annually. Attendance at the convention included members from all industrial centers from coast to coast.

Speakers at the two-day convention included Col. H. A. Toulmin, Jr., Dayton, Ohio; Walter E. Blank, National Cash Register Co., and others.

John Sauer, Jr., Peninsula Machinery Co., Detroit, was renamed vice-president and the following new members of the executive committee are: William T. Todd, Jr., Somers, Fitler & Todd Co., Pittsburgh; George Habicht, Marshall & Huschart Machinery Co., Chicago, and John Cetrule, Triplex Machine Tool Co.

A. G. BRYANT

FOR MORE THAN 40 YEARS



HANNA RIVETERS

have been preferred by fabricators. Available in several styles and sizes permitting selection of a standard riveter to meet just about every requirement.

A single squeeze sets a rivet—the rated tonnage of the riveter is exerted during a generous portion of the die travel, assuring each rivet receiving the correct tonnage, and variation in grips up to one half inch automatically taken care of. This is a decided advantage over the plain toggle type of riveter where tonnage is exerted on the rivet at only the instant the toggles snap over.

Ask for Catalogue 227 illustrating different applications.

HANNA ENGINEERING WORKS

1761 ELSTON AVENUE - CHICAGO, ILLINOIS

Republic's New Stack Blown In

YOUNGSTOWN.—Republic Steel Corp's new 1000-ton No. 3 furnace here was blown in Oct. 5, following ceremonies in which Mayor Lionel Evans lighted the furnace. It replaces a 500-ton furnace at the corporation's Youngstown plant.

Roy L. Leventry, Youngstown district manager of Republic, was host to the group of guests at luncheon in the plant and for a tour of inspection through the enlarged coke works which are to be placed in operation later this month. The guests included public officials and J. C. Barrett, dean of blast furnace men in the United States, who is connected with the Ohio works of Carnegie-Illinois Steel Co., and William B. Pollock, II, president William B. Pollock Co., Youngstown, which built the furnace.

G-E Third Quarter Sales Decline 31 Per Cent

ORDERS received by General Electric Co. during the third quarter of 1938 amounted to $60,533,135, compared with $88,010,937 during the same quarter last year, a decrease of 31 per cent, President Gerard Swope announced. Orders received in the first and second quarters decreased 38 per cent and 44 per cent, respectively, from the corresponding periods last year.

Falk Awarded Order For Three Gear Drives

FALK CORP., Milwaukee, has received an order from the American Rolling Mill Co., Middletown, Ohio, for three large reduction gear drives for its continuous strip mill now undergoing modernization.

Pittsburgh Steel Gets Lead-Bearing Steel License

PITTSBURGH STEEL CO. has received a license from the Inland Steel Co. to produce its new lead-bearing steels developed under the trade name Ledloy.

MONTHLY SHIPMENTS OF FINISHED STEEL PRODUCTS BY UNITED STATES STEEL CORP.—TONS

Month	1934 Shipments	1934 Per Cent of Capacity	1935 Shipments	1935 Per Cent of Capacity	1936 Shipments	1936 Per Cent of Capacity	1937 Shipments	1937 Per Cent of Capacity	1938 Shipments	1938 *Per Cent of Capacity
January	331,777	19.8	534,055	31.9	721,414	44.8	1,149,918	75.4	518,322	33.7
February	385,500	25.9	583,137	39.2	676,315	45.3	1,133,724	82.5	474,723	35.5
March	588,209	35.2	668,056	41.5	783,552	50.5	1,414,399	92.7	572,199	37.2
April	643,009	41.5	591,728	36.7	979,907	63.2	1,343,644	91.0	501,972	33.7
May	745,063	44.5	598,915	35.8	984,097	63.4	1,304,039	85.5	465,081	30.2
June	985,337	61.2	578,108	36.7	886,065	57.1	1,268,550	85.8	478,057	32.1
July	369,938	23.9	547,794	34.0	950,851	61.3	1,186,752	77.9	441,570	28.8
August	378,023	22.6	624,497	37.3	923,703	59.6	1,107,858	72.6	558,634	36.3
September	370,306	23.9	614,933	39.7	961,803	62.0	1,047,962	71.1	577,666	37.4
October	343,962	20.6	686,741	41.1	1,007,417	62.6	792,310	52.0	.....	...
November	366,119	22.7	681,820	42.3	882,643	59.2	587,241	39.7	.....	...
December	418,630	27.0	661,515	42.7	1,067,365	68.8	489,070	32.1	.....	...
Minus yearly adjustment	(—19,907)	...	(—23,750)	...	(—40,859)	...	(—77,113)	...	.....	...
Total for year	5,905,966	30.6	7,347,549	38.1	10,784,273	58.2	12,748,354	70.4	.....	...

*Annual capacity 18,114,000 gross tons, with monthly percentages based on actual number of weeks in each month.

U. S. Steel Shipments Climb in September

UNITED STATES STEEL CORP. subsidiaries shipped 577,666 tons of finished steel products in September, compared with 558,634 tons in August, an increase of 19,032 tons, and with 1,047,962 tons in 1937. Shipments for the first nine months of 1938 totaled 4,588,224 tons against 10,956,846 tons in the comparable period of last year.

Dravo Gets Order For Six Light Towers

PITTSBURGH. — Dravo Corp., Pittsburgh, has booked six light towers for the Superintendent of Lighthouses, United States Department of Commerce, Key West, Fla., for use in Tampa Bay. Approximately 120 tons of steel, including galvanized pipe, will be utilized.

WHY?

"Gusher" Coolant Pumps deserve your consideration because they never take time out to be packed or primed. This means *more profit* for you through the uninterrupted operation of your machine tools.

THE RUTHMAN MACHINERY COMPANY
537 EAST FRONT ST., CINCINNATI, OHIO

Model "TL" Gusher Pump with Polyphase Motor.

GUN WELDERS

SWIFT ELECTRIC WELDER CO., 6560 Epworth Blvd., Detroit, Mich., Welding machines hand, hydraulic, cam or air operated of the following types: spot, seam, projection, flash, flue & pipe.

Industry Speaks

CHARLES R. HOOK, president, National Association of Manufacturers — "The manufacturers of this country have a few major objectives which many people do not seem to understand. First, industrialists want to see a sound business recovery so that there will be plenty of jobs. Industry wants to see a higher income for every family so that every family can afford to buy more of the products and services of industry."

FREDERICK E. WILLIAMSON, president, New York Central System — "A wage scale beyond the capacity of the railroad industry to bear is a most serious disservice to the men themselves. The less prosperous the railroad business the fewer the men who can be employed and the larger the number of men who must either be furloughed or permanently let out. Higher wage rates that carry with them a higher percentage of unemployment are as bad for the men as for the railroads."

Industry Listens

"The whole world is at the crossroads of personal liberty and autonomous government. We are no exception to the rule except as a matter of degree. We have no divine immunity to the seeping, sweeping forces of autocracy that elsewhere have freedom by the throat. On the contrary, we too have felt both the promise and the pressure of the iron heel." — SENATOR ARTHUR H. VANDENBERG.

"The steel industry has always contributed fundamentally to our national economy and to the national wellbeing. This increasingly important relationship has been brought about through research endeavors that have been successful not only in effecting economies in production but in broadening the utility of this basic research. To the extent that the industry continues this research and solves problems in human relations through greater consideration of social responsibilities, the public weal will be constructively served and the industry will proportionately strengthen the assets of public confidence."

—PRESIDENT ROOSEVELT.

REINFORCING STEEL

. . . *Awards of 3850 tons, 11,100 tons in new projects*

NORTH ATLANTIC STATES

AWARDS

500 **Tons,** Pittsburgh, 33rd Street sewer, to Fort Pitt Bridge Works, Pittsburgh.

150 **Tons,** Fort Niagara, N. Y., barracks, to Bethlehem Steel Co., Bethlehem, Pa., through Ross Engineering Co., Washington, contractor.

150 **Tons,** Harrisburg, Pa., joists for two apartment houses, to Concrete Engineering Co.

100 **Tons,** Blacksburg, Va., dormitory building, Virginia Polytechnic Institute, to Bethlehem Steel Co., through J. J. McDevitt, contractor.

100 **Tons,** Providence, R. I., power house, to Bethlehem Steel Co.

CENTRAL and WESTERN STATES

1450 **Tons,** San Francisco, tunnel approach to Golden Gate Bridge, to Ceco Steel Products Co., San Francisco, through Macco Construction Co., South San Francisco.

400 **Tons,** Circleville, Ohio, Pickaway County project ER-45-A, to Bethlehem Steel Co., Bethlehem, Pa., through Lewis & Frisinger, Ann Arbor, Mich., contractor.

309 **Tons,** Mare Island, Cal., Navy award for hospital ward, to W. S. Wetenhall Co., San Francisco.

234 **Tons,** Chicago, WPA, to Truscon Steel Co.

180 **Tons,** Ypsilanti, Mich., sewage disposal plant, to Joseph T. Ryerson & Son, Inc., Chicago, through Stranberg Specer Co., contractor.

164 **Tons,** Mare Island, Cal., Navy award for ammunition storehouses, to Truscon Steel Co., San Francisco.

100 **Tons,** Minneapolis, Church of Christ, to Concrete Steel Co., New York.

NEW PROJECTS

NORTH ATLANTIC STATES

1366 **Tons,** Boston, Treasury Department, Procurement Division; Carnegie-Illinois Steel Corp., Pittsburgh, low bidder.

1300 **Tons,** Rochester, N. Y., Eastman Kodak Co. building.

390 **Tons,** Beltsville, Md., cold storage research laboratory.

340 **Tons,** Chester, Pa., sewage disposal plant; bids in.

325 **Tons,** Saranac Lake, N. Y., mostly mesh, highway project R.C. 3989, Belmar Contracting Co., Inc., Troy, N. Y., low bidder.

250 **Tons,** Butler, Pa., municipal sewage disposal plant.

250 **Tons,** Sharon, Pa., municipal sewage disposal plant.

250 **Tons,** Uniontown, Pa., municipal sewage disposal plant.

250 **Tons,** Greensburg, Pa., municipal sewage disposal plant.

250 **Tons,** Warren, Pa., municipal sewage disposal plant.

225 **Tons,** Washington, municipal court building.

201 **Tons,** Penn Yan, N. Y., mostly mesh, highway project, R.C. 3991, Mohawk Paving Co., Inc., Buffalo, low bidder.

150 **Tons,** Homer, N. Y., mostly mesh, highway project 8522, Bero Engineering & Construction Corp., North Tonawanda, N. Y., low bidder.

145 **Tons,** Trenton, N. J., sewage disposal plant; bids in.

140 **Tons,** Bellefonte, Pa., municipal sewage disposal plant.

100 **Tons,** Sharpsville, Pa., municipal sewage disposal plant.

100 **Tons,** Torrance, Pa., water reservoir, Torrance State Hospital.

100 **Tons,** Latrobe, Pa., municipal sewage disposal plant.

CENTRAL and WESTERN STATES

600 **Tons,** Fort Lewis, Wash., barracks; George A. Fuller Co., Los Angeles, general contractor.

575 **Tons,** St. Joseph, Mo., post office.

500 **Tons,** Los Angeles, United States Engineer (Proposal 170); bids opened.

500 **Tons,** Berkeley, Cal., Farm Credit Administration building; bids Oct. 26.

444 **Tons,** St. Joseph, Mo., post office and court house, E. Blair, St. Charles, La., low bidder.

350 **Tons,** San Francisco, ward buildings at Presidio; bids Nov. 15.

218 **Tons,** Saticoy, Cal., reconstruct bridge; bids Oct. 27.

216 **Tons,** Illinois State Procurement Office; bids Oct. 13.

204 **Tons,** Bells Station, Cal., highway bridges; bids Oct. 26.

200 **Tons,** Madison, Wis., nurses' home.

159 **Tons,** Corcoran, Cal., high school; W. W. Petley, Los Angeles, general contractor.

150 **Tons,** Detroit, surge basin. Unstated tonnage, Alpena, Mich., bridge; bids Oct. 14.

150 **Tons,** Leavenworth, Kan., penitentiary.

137 **Tons,** Calexico, Cal., All-American Canal project (Invitation B-42155-A); bids opened.

121 **Tons,** Waukegan, Ill., Lake County sanitarium; Charles B. Johnson & Son, low bidders.

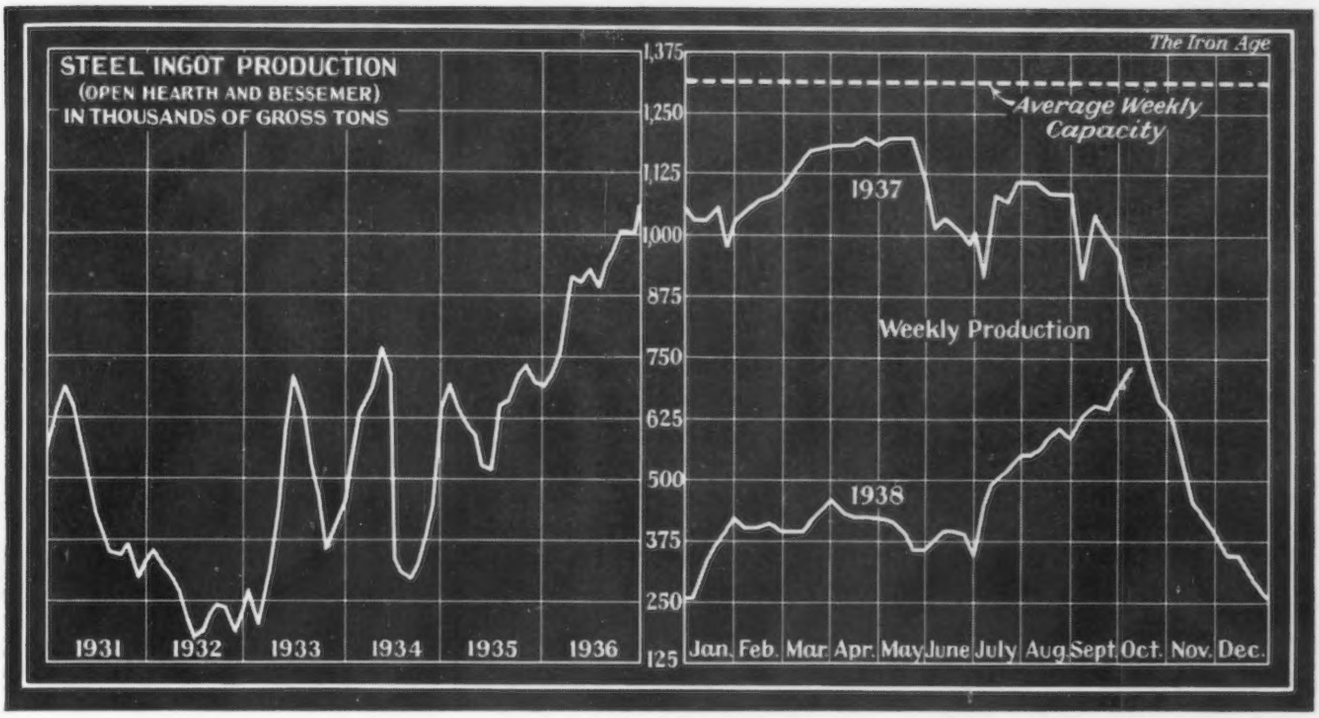
119 **Tons,** Clark and Green Counties, Ohio, State bridge; Midland Construction Co., Columbus, Ohio, low bidder.

115 **Tons,** Clear Creek County, Colo., highway bridges; bids Oct. 14.

114 **Tons,** South Pasadena, Cal., bridges across Arroyo Seco Parkway; bids Oct. 27.

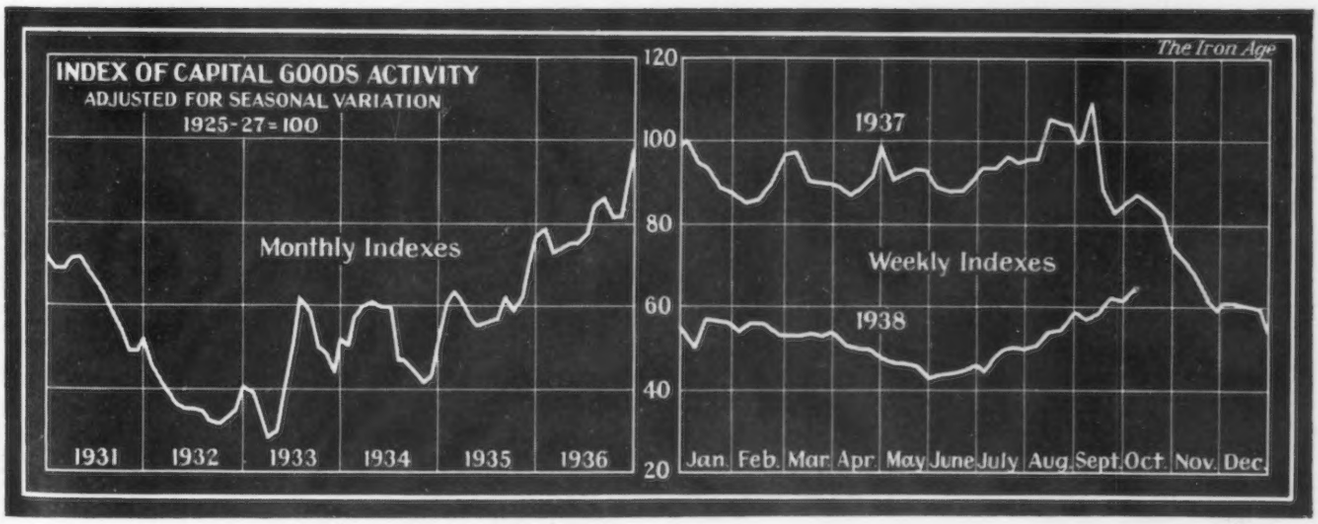
110 **Tons,** Indianapolis, Central State Hospital.

Steel Output Climbs 2½ Points to 51½ Per Cent of Capacity



District Ingot Production, Per Cent of Capacity		Pitts-burgh	Chicago	Valleys	Phila-delphia	Cleve-land	Wheel-ing	Buffalo	Detroit	Southern	S. Ohio River	Western	St. Louis	East ern	Aggre-gate
	CURRENT WEEK..	41.0	46.0	53.0	32.0	53.0	76.0	52.0	64.0	49.0	55.5	50.0	50.0	75.0	**51.5**
	PREVIOUS WEEK..	38.0	45.0	55.0	30.0	51.0	72.0	52.0	60.0	46.5	43.0	40.0	49.5	50.0	**49.0**

Capital Goods Index Up 3.3 Points to 65.1, High for Year



AGAIN of 48 per cent in automobile assemblies, plus minor gains in all the other indices except heavy engineering construction, has pushed THE IRON AGE capital goods index up 3.3 points, or 5.3 per cent, to 65.1, highest index level reached in 1938, although still well under the figure of 88.3 prevailing a year ago. At that time, however, the general trend was downward, whereas a general upward movement has been in effect since early June. Actually, engineering contract awards gained 38 per cent over the previous week, and the loss in the index is found in the 13-month moving average used as a base.

	Week Ended Oct. 8	Week Ended Oct. 1	Comparable Week 1937	Comparable Week 1929
Steel ingot production[1]	65.9	64.0	92.2	110.3
Automobile production[2]	68.5	54.6	131.0	112.5
Construction contracts[3]	73.9	74.6	54.5	108.4
Forest products carloadings[4]	58.4	57.4	69.7	112.0
Production and shipments, Pittsburgh District[5]	58.8	58.3	94.1	117.3
Combined index	**65.1**	**61.8**	**88.3**	**112.1**

Sources: 1. THE IRON AGE; 2. Ward's Automotive Reports; 3. *Engineering News-Record;* 4. Association of American Railroads; 5. University of Pittsburgh.

. . . SUMMARY OF THE WEEK . . .

. . . Prices of some flat rolled products break $4 a ton.

° ° °

. . . Decline originated at Detroit, but spreads to a wider area.

° ° °

. . . Ingot production higher at 51.5 per cent; orders gain.

A BREAK of $4 a ton in prices of some flat rolled products is the culmination of irregularities in quotations over recent weeks. This outright decline, which has affected hot and cold rolled sheets, enameling sheets, long ternes and hot rolled strip, originated at Detroit, but has quickly extended into a wider area.

The Carnegie-Illinois Steel Corp. took official notice of the situation by issuing this statement on Tuesday:

"There has been in the past few days a general weakness in the sheet market, but this has not been instigated by the Carnegie-Illinois Steel Corp., which is only remaining competitive."

Some companies have notified their customers that shipments as of Oct. 10 will take the lower prices, with the understanding, however, that the current quotations are subject to withdrawal without notice.

Two of the products affected—hot rolled sheets and hot rolled strip—are components of THE IRON AGE finished steel composite price, which has been adjusted to 2.236c. a lb., the lowest figure recorded since the issue of Dec. 23, 1936.

Other steel products are not quotably lower, but concessions have become more numerous on several, including galvanized sheets, wire nails, and steel plates, the latter being affected chiefly in the East.

Coincident with the weakness in steel prices, pig iron quotations are firm at the recently announced $1 a ton advance, which has now become unanimous, bringing about a further slight rise in THE IRON AGE pig iron composite price to $20.61, while the scrap composite price is unchanged at $14.25. Scrap is marking time, but a sharp rise in steel ingot output this week has added to the bullishness of scrap dealers, who expect that any increase in mill buying will be immediately reflected in higher scrap prices.

THE gain in steel ingot output this week to 51.5 per cent from 49 per cent last week is the sharpest rise within one week this year, excepting post-holiday recoveries. In the corresponding week last year ingot output was at 63.5 per cent, but was rapidly declining, having dropped to 48 per cent by the first week of November, which makes it appear that fourth quarter production this year will top that of the final quarter last year by a fairly substantial margin.

As indicative of business recovery, THE IRON AGE capital goods index has risen 3.3 points to 65.1, the highest level thus far in 1938, and compares with 88.3 one year ago. The rise has been largely accounted for by automobile assemblies, but other components have also registered gains.

New business in steel has gained consistently during the past two weeks. All products have not been affected in the same degree, but most of them have had moderate gains. Releases of structural shapes against recent construction contracts have shown conspicuous improvement and account in part for a three-point gain in operations at Pittsburgh to 41 per cent. An expanding volume of automobile steel tonnage is expected this week.

New lettings of fabricated structural steel amount to 22,000 tons, including 7500 tons for Hunter College buildings, New York; 1900 tons for the Soviet Government's building at the New York World's Fair and 1285 tons for a machine shop at the Philadelphia Navy Yard. New projects of 31,000 tons include 7500 tons for buildings for the Youngstown Sheet & Tube Co. at Indiana Harbor, Ind.; 4000 tons for a shop at the Philadelphia Navy Yard; 3500 tons for a shop at the Mare Island Navy Yard; 3500 tons for a bridge in Kansas; 1700 tons for Veterans Hospital buildings, New York; and 1200 tons for repairs to Williamsburgh Bridge, New York. New reinforcing steel projects call for 11,000 tons.

Shipbuilding tonnage promises to become a more important factor soon. The Navy Department has awarded a destroyer tender and a seaplane tender to the New York Shipbuilding Corp., these ships requiring 7700 tons of plates and 3700 tons of shapes. Contracts for cargo ships are expected soon from the Maritime Commission.

The Public Service Gas Co., Minneapolis, has applied to the Federal Power Commission for a permit to build a 1500-mile natural gas line in northwestern states.

One of the largest inquiries for railroad equipment in some time is from the Union Pacific, which will buy 30 locomotives.

A Comparison of Prices

Market Prices at Date, and One Week, One Month, and One Year Previous

Advances Over Past Week in Heavy Type, Declines in Italics

Rails and Semi-finished Steel

Per Gross Ton:	Oct. 11, 1938	Oct. 4, 1938	Sept. 13, 1938	Oct. 12, *1937
Rails, heavy, at mill	$40.00	$40.00	$42.50	$42.50
Light rails: Pittsburgh, Chicago, Birmingham	40.00	40.00	40.00	43.00
Rerolling billets: Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham, Sparrows Point	34.00	34.00	34.00	37.00
Sheet bars: Pittsburgh, Chicago, Cleveland, Youngstown, Buffalo, Canton, Sparrows Point	34.00	34.00	34.00	37.00
Slabs: Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham, Sparrows Point	34.00	34.00	34.00	37.00
Forging billets: Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham	40.00	40.00	40.00	43.00
Wire rods: Nos. 4 and 5, Pittsburgh, Chicago, Cleveland	43.00	43.00	43.00	47.00
Skelp, grvd. steel: Pittsburgh, Chicago, Youngstown, Coatesville, Sparrows Point, cents per lb.	1.90	1.90	1.90	2.10

Finished Steel

Cents Per Lb.:				
Bars: Pittsburgh, Chicago, Gary, Cleveland, Buffalo, Birmingham	2.25	2.25	2.25	2.45
Plates: Pittsburgh, Chicago, Gary, Birmingham, Sparrows Point, Cleveland, Youngstown, Coatesville, Claymont	2.10	2.10	2.10	2.25
Structural shapes: Pittsburgh, Chicago, Gary, Buffalo, Bethlehem, Birmingham	2.16	2.10	2.10	2.25
Cold finished bars: Pittsburgh, Buffalo, Cleveland, Chicago, Gary	2.70	2.70	2.70	2.90
Hot rolled strip: Pittsburgh, Chicago, Gary, Cleveland, Middletown, Youngstown, Birmingham	*1.95*	2.15	2.15	2.40
Cold rolled strip: Pittsburgh, Cleveland, Youngstown	2.95	2.95	2.95	3.20
Sheets, galv., No. 24: Pittsburgh, Gary, Sparrows Point, Buffalo, Middletown, Youngstown, Birmingham	3.50	3.50	3.50	3.80
Hot rolled sheets: Pittsburgh, Gary, Birmingham, Buffalo, Youngstown, Middletown, Sparrows Point, Cleveland,	*1.95*	2.15	2.15	...
Cold rolled sheets: Pittsburgh, Gary, Buffalo, Youngstown, Cleveland, Middletown	*3.05*	3.20	3.20	...
Wire nails: Pittsburgh, Chicago, Cleveland, Birmingham	2.45	2.45	2.45	2.75
Plain wire: Pittsburgh, Chicago, Cleveland, Birmingham	2.60	2.60	2.60	2.90
Barbed wire, galv.: Pittsburgh, Chicago, Cleveland, Birmingham	3.20	3.20	3.20	3.40
Tin plate, 100 lb. base box: Pittsburgh and Gary	$5.35	$5.35	$5.35	$5.35

*Pittsburgh prices only.

Pig Iron

Per Gross Ton:				
No. 2 fdy., Philadelphia	$22.84	$21.84	$21.84	$25.76
No. 2, Valley furnace	21.00	21.00	20.00	24.00
No. 2, Southern Cin'ti	21.06	21.06	20.06	23.69
No. 2, Birmingham	17.38	17.38	16.38	20.38
No. 2, foundry, Chicago†	21.00	21.00	20.00	24.00
Basic, del'd eastern Pa.	22.34	21.34	21.34	25.26
Basic, Valley furnace	20.50	20.50	19.50	23.50
Malleable, Chicago†	21.00	21.00	20.00	24.00
Malleable, Valley	21.00	21.00	20.00	24.00
L. S. charcoal, Chicago	28.34	28.34	28.34	30.04
Ferromanganese, seab'd carlots	92.50	92.50	92.50	102.50

†The switching charge for delivery to foundries in the Chicago district is 60c. per ton.

Scrap

Per Gross Ton:				
Heavy melting steel, P'gh	$15.25	$15.25	$15.25	$17.25
Heavy melting steel, Phila.	14.75	14.75	14.25	16.75
Heavy melting steel, Ch'go	12.75	12.75	13.75	14.75
Carwheels, Chicago	13.25	13.25	14.25	17.25
Carwheels, Philadelphia	16.75	16.75	17.25	19.25
No. 1 cast, Pittsburgh	15.50	15.50	15.50	18.75
No. 1 cast, Philadelphia	16.75	16.75	16.25	19.25
No. 1 cast, Ch'go (net ton)	12.25	12.25	13.25	13.50
No. 1 RR. wrot., Phila.	15.25	15.25	15.25	19.75

Coke, Connellsville

Per Net Ton at Oven:				
Furnace coke, prompt	$3.75	$3.75	$3.75	$4.25
Foundry coke, prompt	4.75	4.75	4.75	5.00

Non-Ferrous Metals

Cents per Lb. to Large Buyers:				
Electrolytic copper, Conn.	**10.75**	10.375	10.125	12.50
Lake copper, New York	**10.875**	10.50	10.25	13.125
Tin (Straits), New York	**44.875**	44.00	42.75	55.75
Zinc, East St. Louis	4.95	4.95	4.75	6.50
Zinc, New York	5.34	5.34	5.14	6.85
Lead, St. Louis	4.95	4.95	4.75	5.85
Lead, New York	5.10	5.10	4.90	6.00
Antimony (Asiatic), N. Y.	14.00	14.00	14.00	18.25

On export business there are frequent variations from the above prices. Also in domestic business, there is at times a range of prices on various products, as shown in our detailed price tables.

The Iron Age Composite Prices

	Finished Steel	Pig Iron	Steel Scrap
October 11, 1938	2.236c. a Lb.	$20.61 a Gross Ton	$14.25 a Gross Ton
One week ago	2.286c.	20.44	14.25
One month ago	2.300c.	19.61	14.42
One year ago	2.512c.	23.25	16.25

Based on steel bars, beams, tank plates, wire, rails, black pipe, sheets and hot-rolled strip. These products represent 85 per cent of the United States output.

Based on average basic iron at Valley furnace and foundry irons at Chicago, Philadelphia, Buffalo, Valley and Southern iron at Cincinnati.

Based on No. 1 heavy melting steel quotations at Pittsburgh Philadelphia and Chicago.

	Finished Steel HIGH	Finished Steel LOW	Pig Iron HIGH	Pig Iron LOW	Steel Scrap HIGH	Steel Scrap LOW
1938	2.512c., May 17	2.236c., Oct. 11	$23.25, June 21	$19.61, July 6	$14.83, Aug. 9	$11.00, June 7
1937	2.512c., Mar. 9	2.249c., Jan. 4	23.25, Mar. 9	20.25, Feb. 16	21.92, Mar. 30	12.92, Nov. 16
1936	2.249c., Dec. 28	2.016c., Mar. 10	19.73, Nov. 24	18.73, Aug. 11	17.75, Dec. 21	12.67, June 9
1935	2.062c., Oct. 1	2.056c., Jan. 8	18.84, Nov. 5	17.83, May 14	13.42, Dec. 10	10.33, Apr. 23
1934	2.118c., Apr. 24	1.945c., Jan. 2	17.90, May 1	16.90, Jan. 27	13.00, Mar. 13	9.50, Sept. 25
1933	1.953c., Oct. 3	1.792c., May 2	16.90, Dec. 5	13.56, Jan. 3	12.25, Aug. 8	6.75, Jan. 3
1932	1.915c., Sept. 6	1.870c., Mar. 15	14.81, Jan. 5	13.56, Dec. 6	8.50, Jan. 12	6.43, July 5
1931	1.981c., Jan. 13	1.883c., Dec. 29	15.90, Jan. 6	14.79, Dec. 15	11.33, Jan. 6	8.50, Dec. 29
1930	2.192c., Jan. 7	1.962c., Dec. 9	18.21, Jan. 7	15.90, Dec. 16	15.00, Feb. 18	11.25, Dec. 9
1929	2.223c., Apr. 2	2.192c., Oct. 29	18.71, May 14	18.21, Dec. 17	17.58, Jan. 29	14.08, Dec. 3
1928	2.192c., Dec. 11	2.142c., July 10	18.59, Nov. 27	17.04, July 24	16.50, Dec. 31	13.08, July 2
1927	2.402c., Jan. 4	2.212c., Nov. 1	19.71, Jan. 4	17.54, Nov. 1	15.25, Jan. 17	13.08, Nov. 22

. . THIS WEEK'S MARKET NEWS . .

STEEL OPERATIONS

. . . Sharp rise in ingot output to 51.5 per cent

A RISE of two and a half points to 51.5 per cent of the country's capacity is recorded in the weekly estimate by THE IRON AGE. The estimate of the American Iron and Steel Institute, issued on Monday, was 51.4 per cent.

Ingot output in the PITTSBURGH district has advanced three points to 41 per cent. The WHEELING-WEIRTON district is up four points to 76 per cent. The CHICAGO district rate continues its steady climb, having gained one point this week to 46 per cent. Two of the CHICAGO mills showed a gain, two were stationary and one showed a slight loss.

In the CLEVELAND-LORAIN area the average is up two points to 53 per cent. Another blast furnace was put in operation at LORAIN, which will result in additional acvtive open hearths within a day or two. A loss of two points to 53 per cent has, however, occurred in the YOUNGSTOWN district owing to the shutting down of a blooming mill for repairs which necessitated the taking off of open hearth furnaces; otherwise the rate there would have been above last week's 55 per cent.

Great Lakes Steel Corp. at DETROIT has announced that three new open hearths have been put into service for the first time and that three of the older furnaces will be shut down for repairs. This continues the Great Lakes level of operations at 12 furnaces out of 16. Together with the Ford Motor Co.'s operation of four furnaces, the DETROIT rate is 64 per cent after a drop of one week to 60 per cent. No further increase is expected until Nov. 1 when Ford will add another open hearth.

In the SOUTHERN OHIO district ingot output rose abruptly this week, from 43 to 55.5 per cent, to reach the highest level of the year thus far. Eighteen of the 33 furnaces in the district are in operation. One producer whose steel-making department has been idle for two weeks has lighted five furnaces.

Operations are slightly higher in the BIRMINGHAM district. In districts other than those mentioned operations are virtually unchanged.

Ingot production in September was 2,657,748 gross tons, equal to 46.28 per cent of the industry's capacity.

NEW BUSINESS

. . . Trend of orders is moderately upward in most districts

NEW business so far this month in the PITTSBURGH district is running ahead of the same period a month ago but comparisons are of little value because of the holidays which started off September. Demand for structural shapes, semi-finished and wire products still predominates, although sheet tonnages, due to automotive and miscellaneous support, have shown some improvement in volume during the past week. Producers there are more than ever of the opinion that a large volume of automotive tonnages will not reach the mills until auto makers have gaged public acceptance of 1939 models.

Incoming business in the CLEVELAND and YOUNGSTOWN districts so far this month has been very satisfactory and is comparable to the volume received in the corresponding period of September. Major support is being supplied by diversified requirements of miscellaneous consumers, who in some cases are quite active.

Bookings continue to run ahead of the comparable period last month in CHICAGO sales offices. Though the gain is slight, it reflects a more optimistic feeling which is becoming general. Considerable additional automoble business is expected sometime this week and the trend is now definitely upward. No noticeable increase has yet been seen from farm equipment makers but more orders are expected later in the month, and prospects for 1939 are said to be good.

More than half of the New York Central's $2,000,000 rail and accessory order was placed in the CHICAGO district, it is understood. Carnegie-Illinois is said to have received about $1,000,000 of the business, and the Gary works will roll the rails. Inland Steel Co. also benefited so that the CHICAGO district will enjoy the lion's share of the order.

In NEW YORK sales have expanded considerably during the past two weeks. Some mills that did not experience much of an uplift in sales week before last had substantially better orders last week. In PHILADELPHIA the trend of orders is moderately upward.

The gain in orders, noted in SOUTHEASTERN OHIO recently was maintained last week. Automobile specifications are expanding moderately, but miscellaneous ordering has leveled off.

There is a strong demand for steel products at BIRMINGHAM. Sheet bookings have been particularly good.

On the PACIFIC COAST, reinforcing bar awards and inquiries showed a slight pickup in numbers, but most of the projects were of small size.

PRICES

. . . Break of $4 a ton on some flat rolled products

CONCESSIONS of $4 a ton on some flat rolled products starting in DETROIT and other auto centers, have spread to other large accounts due to a progressively intense competition among sheet makers. This weakness springs primarily from the tremendous flat rolled capacity resulting from the entry into production of numerous new continuous wide strip mills.

The wave of price competition has spread so rapidly both as to companies and consumers involved, that the going price at present on hot rolled strip, hot and cold rolled sheets, enameling sheets, and long ternes is down $4 a ton from the recent published prices. This is the situation, not by public announcement on the part of any company, but by actual selling practices. The widespread concessions are subject to change without notice.

So far the price weakness has been confined to the products mentioned above and the general situation with respect to other steel products remains as it has been in the past few weeks. Steel items with secondary outlets such as galvanized sheets, merchant wire

products and standard pipe, continue spotty in price as heretofore.

The Carnegie-Illinois Steel Corp. took official cognizance of the situation by issuing the following brief announcement:

"There has been in the past few days a general weakness in the sheet market, but this has not been instigated by the Carnegie-Illinois Steel Corp., which is only remaining competitive."

Paul Mackall, vice-president in charge of sales, Bethlehem Steel Co., officially denied reports that Bethlehem had led the price cut of $4 per ton on hot and cold rolled sheets at Detroit.

"Companies other than Bethlehem made the price," he said, "and we are obliged to meet the competition."

IRON ORE

. . . Season's movement probably will not reach 20,000,000 tons

AS the navigation season on the Great Lakes nears an end, hopes for an iron ore movement of 20,000,000 tons have been abandoned by most observers. Estimates of the probable total seasonal movement from upper Lake ports now are placed around 18,000,000 to 19,000,000 tons. Up to Oct. 1, 14,157,290 tons had been brought down.

PIG IRON

. . . Recent $1 price advance now general . . . Shipments are gaining

THE recent price advance of $1 a ton on pig iron has now become general throughout the country, an important Eastern producer having followed competitors in this move during the past week. Nearly all buyers have covered their fourth quarter requirements.

Shipments are increasing at a moderate rate. At CLEVELAND shipments are running about 10 per cent ahead of those in the corresponding September period, while in the eastern Pennsylvania district they are up 10 to 15 per cent. A leading CHICAGO producer reports that its shipments are up 6 per cent over those of the like period last month, while releases continue to gain in volume at PITTSBURGH, PHILADELPHIA, CINCINNATI and elsewhere.

Many foundries in the CHICAGO area are now running four or five days a week as compared with two or three days a short time ago. Better operations among jobbing foundries are reported from PITTSBURGH, radiator manufacturers in that district also being more active. Heating foundries in the CINCINNATI area are also busier.

The situation in the South is particularly encouraging as a result of recent heavy bookings. In the BIRMINGHAM district 15 of 18 blast furnaces are in blast.

SEMI-FINISHED STEEL

. . . Non-integrated mills are ordering more liberally

NON-INTEGRATED makers have shown a slightly more liberal ordering policy, but buying for the most part continues hand-to-mouth. Orders at PITTSBURGH in the past week gained substantially from a week ago with demand fairly well distributed, both as to product and consuming sources. Automotive business has helped movement of rods and forging billets, while building construction has effected a brisk movement in skelp. Prices are firm.

PLATES

. . . Price concessions become more common in the East

PRICE concessions on plates, usually amounting to $2 a ton, are becoming more common in the East. Though sometimes masked under fabrication-in-transit arrangements, they have also been made in the base prices. Some mills in the Pittsburgh district and in Ohio have declined business at 2.19c. a lb., New York, which would work back to 1.83c., Pittsburgh, or 1.78c., Cleveland. The export price on plates is now 1.76c. a lb., f. a. s.

Plate tonnage is not making important gains, but some mills in the central district are getting more orders than they had during the comparable period of September. In the East there is a lull, but pending shipbuilding contracts are expected to furnish tonnage in the near future. The Maritime Commission is taking bids on new ships this month.

The Navy Department has awarded a destroyer tender and a seaplane tender to the New York Shipbuilding Corp., Camden, N. J. The two ships will take 7700 tons of plates and 3700 tons of shapes.

Low bids on the Colorado River aqueduct for the Los Angeles Metropolitan Water District were for lock joint steel cylinder reinforced pre-cast concrete pipe instead of the alternate welded steel plate pipe. This indicates that 2160 tons of plates and sheets and 4700 tons of bars will be used instead of the 7680 tons of plates that would have been required if steel plate pipe were used. American Concrete & Steel Pipe Co., South Gate, Cal., was low on 6.8 miles of aqueduct at $532,708; United Concrete Pipe Corp., Torrance, Cal., was low on the remaining 6.7 miles at $498,640.

The Central Barge Co., CHICAGO, may within the next two or three weeks issue inquiries for 30 to 40 steel barges, 195 ft. by 35 ft. 7 each to require about 160 tons of plates. The estimated steel cost in each barge is $10,000. They will be used in inland waterway service.

Of 2700 tons of plates required for the Criminal Courts Building, NEW YORK, about half has been awarded to an Eastern steel company.

(Details of fabricated plate awards and inquiries will be found on page 313).

MERCHANT BARS

. . . Gains expected from automotive and farm implement demand

A WIDELY diversified demand has helped to maintain the recent improvement in sales of merchant bars, further support being expected from the automobile industry and the manufacturers and farm implements and tractors. Sales to jobbers have been in fairly good volume. The CHICAGO mills expect to benefit from increased production of farm machinery, while at CLEVELAND forgers have come into the market for carload lots. At PITTSBURGH the bookings during the week compared favorably with those of the previous week.

STRUCTURAL STEEL

. . . 7300-Ton order for Hunter College building to Harris Structural Steel

HARRIS STRUCTURAL STEEL CO., Plainfield, N. J., this week booked a 7500-ton order for structural shapes to be used in a building for Hunter College, New York. This was the largest fabricated structural steel letting of the week in the NEW YORK or any other area.

Meanwhile construction work at

CHICAGO is confined largely to small highway projects, with few large jobs pending, prices unimproved and the market weak while structural lettings at PITTSBURGH gained considerably in the past week and a further increase is anticipated from Government-sponsored projects.

At ST. LOUIS demand for shapes from fabricators continues light with projects pending less than 100 tons each, and fabricators operating at from 25 to 30 per cent of capacity. WEST COAST steel men still await award of the general contract on the Tacoma, Wash., Narrows Bridge, involving 12,000 tons of shapes and piling, 3817 tons of cable wire and 1618 tons of reinforcing bars. Bids are expected soon on a machine shop, to require 3000 to 4000 tons of steel, at the Mare Island, Cal., Navy Yard, BUFFALO reports an increase in projects of moderate tonnage.

(Details of fabricated structural steel awards and inquiries will be found on page 313.)

BOLTS, NUTS, RIVETS

. . . Automotive releases gain slightly at Pittsburgh

RELEASES are more active at PITTSBURGH this week, due to a slight increase in automotive requirements. Orders from structural shops are in fair volume. Producers are operating at about 35 per cent of capacity.

At CLEVELAND the current month has started off slower than expected. However, aggregate volume there is comparable to that of the first 10 days of September.

SHEETS AND STRIP

THE important news is the break of prices on some flat rolled products, which is reported under the heading, "Prices."

This comes at a time when the industry was looking to the automobile makers for an increasing volume of orders. The volume of new business at PITTSBURGH increased slightly during the past week with no particular consuming source responsible. CHICAGO mills are confident that important automobile tonnage will be seen before the end of the week. In that center no appreciable gain has been noted in the demand from miscllaneous sources or from farm equipment, stove and refrigerator manufacturers. At CLEVELAND incoming tonnage thus far in October has not quite equaled the volume in the corresponding September period. Sheet mills in the SOUTHERN OHIO district received orders in the past week equal to about 50 per cent of capacity. Demand for galvanized sheets was especially strong.

REINFORCING BARS

. . . West Coast demand active . . . Prado Dam job is awarded

PICKUP in new projects on the WEST COAST, where an award for 1450 tons for a tunnel on the San Francisco approach to the Golden Gate Bridge went to Ceco Steel Products Co., San Francisco, was a highlight this past week in a market which continued irregular for the country as a whole. Construction award for Prado Dam, near Los Angeles, involving 5350 tons of reinforcing bars, went to W. R. Callahan Construction Co., J. P. Shirley, Guthrie, Marsch, Peterson Co., and George W. Condon Co., combination low bidders.

A number of fair tonnages are in contractors' hands in the CHICAGO area, with jobs above 100 tons scarce and little steel placed in the past week. Pending projects at ST. LOUIS, with Federal projects reported slow in coming out, amounted to several thousand tons in the aggregate.

Carnegie-Illinois Steel Corp. is low bidder on 1366 tons of bars for a U. S. Treasury job at BOSTON while 15 municipal sewage disposal plant projects in the PITTSBURGH district will take 1500 tons of bars. Reinforcing bar prices are soft in the East, after showing some signs of stabilization, and sharp concessions on large jobs are reported. Demand at BUFFALO continues light with a few small tonnages moving.

(Details of reinforcing bar awards and inquiries will be found on page 304).

WIRE PRODUCTS

. . . Demand, already fairly good, expected to gain

WIRE bookings at PITTSBURGH continue to hold recent gains and, if anything, a further improvement has materialized in manufacturers' wire specifications. Demand is highly miscellaneous and includes requirements from toy makers, spring manufacturers, and bolt and nut interests. Weakness in nail prices to jobbers, which originated in the East, has spread to the PITTSBURGH district. Prices to consumers appear to be holding.

While new business to date at CLEVELAND is slightly behind that of last month, the comparison is close and in all likelihood October will finally result in a moderate increase. Manufacturers' wire and export demand are the mainstays of the market.

Automobile business is being received in CHICAGO sales offices and more is yet to come. Better outlook for the farm implement and tractor makers will aid wire mills, and the usual general fall buying from the rural areas should be seen before long. Manufacturers' wire continues to perform well.

Fall bookings in the ST. LOUIS area have been disappointing, but some improvement is looked for within the next two weeks.

COLD FINISHED BARS

. . . Individual bookings small . . . Automotive tonnages fair

ORDERS so far this month are about even with a month ago and demand continues highly miscellaneous, with individual bookings small. Auto tonnages have been fair but are intermittent; better support from this source is expected after motor companies gage public acceptance of new models later in the year.

TUBULAR GOODS

. . . 1500-mile pipe line in Northwestern States is proposed

THE Public Service Gas Co., a Montana corporation with offices in Minneapolis, has applied to the Federal Power Commission for a certificate of convenience and necessity to authorize the construction of a 1500-mile natural gas pipe line from Montana and Wyoming through North Dakota into South Dakota, Minnesota and Wisconsin. The estimated cost is $49 402,000. A few weeks ago the Kansas Pipe Line & Gas Co., Norton, Kan., applied for a $20,000,000 RFC loan to build a gas pipe line from Kansas to the Mesaba iron range. Whether either of these lines will be built is still a question.

Oil-country goods specifications at

PITTSBURGH in the past week were in no smaller volume than in the preceding week. Standard pipe orders have gained impetus from construction work. General repair and replacements in industrial plants have resulted in better pressure tube bookings recently.

The Bureau of Reclamation, Denver, has taken bids on 2,000,000 ft. of 1-in. black steel pipe.

TIN PLATE

. . . Operations still low . . . Market situation unchanged

OPERATIONS continue at 25 to 30 per cent, with little or no change in the market picture. Consumers are going to great lengths to make inventories suit requirements, even to the extent of moving material from one plant to another. This tight situation is expected to prevail until price announcements are made later in the year. Meanwhile a large potential tin plate demand is piling up, which may break loose early next year.

Fourth Quarter Steel Loadings Fall Off

WASHINGTON. — Loadings of iron and steel in the fourth quarter of 1938 are estimated at 268,963 cars, a decrease of 7.5 per cent under actual loadings of 290,734 cars in a corresponding period of last year, according to the Shippers' Advisory Boards of the Association of American Railroads. Freight loadings of 29 principal commodities in the fourth quarter of 1938 are estimated at 5,318,986 cars, a decline of 3.6 per cent under actual loadings of 5,516,292 cars in the fourth quarter of 1937.

Actual and estimated loadings of some of the principal products follow:

	Fourth Quarter Carloadings	
	Actual 1937	Estimated 1938
Coal and Coke	1,958,081	1,948,482
Ore and Concentrates	268,583	215,644
Machinery and Boilers	34,909	25,850
Agricultural Implements and Vehicles other than automobiles	19,463	14,106
Automobiles, Trucks and Parts	168,031	151,037

Skin Pass Mill Installed By Great Lakes Steel Corp.

INSTALLATION of a skin pass mill with an edging stand and a tension coiler, built by Lewis Foundry & Machine Division of Blaw-Knox Co., has been completed at the plant of the Great Lakes Steel Corp., Detroit. The mill is an 8 in. diameter by 10 in. face two-high unit, to be used for skin passing cold slit strip in sizes from 0.5 to 6 in. wide and 0.012 to 0.125 thick.

The units are all roller bearing equipped throughout, and capable of rolling speeds of 400 to 1200 f.p.m. A 40-hp. motor, 400 to 1600 r.p.m., supplies the motive power, driving through a flexible coupling to a combination gear drive and pinion stand and then through universal spindles to the mill rolls.

Imports at Philadelphia

DURING the past week 10 tons of steel bars, 30 tons of steel tubes and 20 tons of steel forgings were received at Philadelphia from Sweden.

Carpenter Steel Co. reports for the year ended June 30, 1938, net income of $246,589 after all charges, compared with a net income of $1,190,679 in the prior year.

. . . CANADA . . .

. . . Domestic demand gaining . . . Production increase expected.

TORONTO, Oct. 11.— Inquiries for iron and steel have improved. Domestic demand for steel is gaining steadily and it is expected that there soon will be further upswing in plant operations in Canada. Prices are steady, with no changes expected for the immediate future.

Production of pig iron is gaining. One or two additional furnaces may blow in soon, but it is also understood that the Steel Co. of Canada will blow out its big furnace for relining.

Trading in iron and steel scrap is more active. Consumers are still interested in special grades and there is a persistent call for cast scrap and heavy melting steel.

Martin Company Erects Drop Hammer Plant

GLENN L. MARTIN CO. has completed and occupied a new building at its plant at Middle River, Md., to be used exclusively for its drop hammer department. The structure has a floor space of 10,000 sq. ft. and, with its new equipment, represents an investment of $75,000. The addition, which immediately quadruples the company's drop hammer capacity and provides for further enlargement contemplated at an early date, makes possible increased use of stamped parts in the manufacture of flying boats and bombardment aircraft.

Woodward Iron Co. reports for the nine months ended Sept. 30, 1938, a net income of $303,696, after all charges, compared with $954,627 in the like period of 1937.

Weekly Bookings of Construction Steel

	Week Ended				Year to Date	
	Oct. 11, 1938	Oct. 4, 1938	Sept. 13, 1938	Oct. 12, 1937	1938	1937
Fabricated structural steel awards	22,200	35,425	17,300	10,275	682,570	881,685
Fabricated plate awards	0	1,150	470	195	99,640	104,905
Steel sheet piling awards	0	1,300	0	0	36,360	37,395
Reinforcing bar awards	3,850	9,000	7,700	8,025	252,950	228,965
Total Letting of Construction Steel .	26,050	46,875	25,470	18,495	1,071,520	1,252,950

. . . NON-FERROUS . . .

. . . Active export and domestic demands force copper up to 10.75c. . . . Lead firm and moderately active following very heavy sales in September . . . Zinc buying lags, but price is strong . . . Tin listless as war scare abates

NEW YORK, Oct. 11.—Taking its cue from intensified armament programs abroad and the possibility of increased industrial activity in the United States, the copper market abroad has shown considerable buoyancy throughout the past week. Prices realized by the cartel a week ago were in the neighborhood of 10.60c., c.i.f., only to mount later to 10.80c. and subsequently rise in steady stages to today's level of 11.10c. per lb., c.i.f., Continental base ports. Following the leadership of this export activity, the domestic price lifted in ⅛c. changes to today's level of 10.75c. a lb., delivered Connecticut Valley points. Demand is brisk at this level for delivery positions over the remainder of the year. Although consumers are judged as being pretty well covered for November and December needs, continued price bullishness could influence a volume of stocking against requirements extending well into next year. This situation could come about in view of the general belief that consumption over the the next few months will overlap output by sizable margins. Domestic sales since the first of the month have amounted to well over 40,000 tons. Export sales over the past week have been running between 1000 and 3000 tons daily.

The Week's Prices. Cents Per Pound for Early Delivery

	Oct. 5	Oct. 6	Oct. 7	Oct. 8	Oct. 10	Oct. 11
Electrolytic copper, Conn.*	10.50	10.625	10.625	10.625	10.75	10.75
Lake copper, N. Y.	10.625	10.75	10.75	10.75	10.875	10.875
Straits tin, spot, New York	43.80	45.00	44.70	....	45.00	44.875
Zinc, East St. Louis	4.95	4.95	4.95	4.95	4.95	4.95
Zinc, New York	5.34	5.34	5.34	5.34	5.34	5.34
Lead, St. Louis	4.95	4.95	4.95	4.95	4.95	4.95
Lead, New York	5.10	5.10	5.10	5.10	5.10	5.10

*Delivered Connecticut Valley; price ¼c. lower delivered in New York.
Aluminum, virgin, 99 per cent plus 20.00c.-21.00c. a lb., delivered.
Aluminum No. 12 remelt No. 2 standard, in carloads, 19.00c. to 19.50c. a lb., delivered.
Nickel, electrolytic, 35c. to 36c. a lb. base refinery, in lots of 2 tons or more.
Antimony, Asiatic, 14.00c. a lb., prompt, f.o.b., New York.
Antimony, American, 11.75c. per lb., prompt shipment, New York.
Quicksilver, $76.00 to $78.00 per flask of 76 lb.
Brass ingots, commercial 85-5-5-5, 11.00c. a lb., less carload, delivered in Middle West ¼c. a lb. is added on orders for less than 40,000 lb.

From New York Warehouse

Delivered Prices, Base per Lb.

Tin, Straits pig	44.75c. to 45.75c.
Tin, bar	46.75c. to 47.75c.
Copper, Lake	12.00c. to 12.50c.
Copper, electrolytic	11.25c. to 12.25c.
Copper, castings	10.75c. to 12.75c.
*Copper sheets, hot-rolled	18.50c.
*High brass sheets	16.875c.
*Seamless brass tubes	19.625c.
*Seamless copper tubes	19.00c.
*Brass rod	12.75c.
Zinc slabs	6.25c. to 7.25c.
Zinc, sheets (No. 9), casks, 1200 lb. and over	10.50c.
Lead, American pig	5.75c. to 6.75c.
Lead, bar	6.50c. to 6.875c.
Lead, sheets, cut	7.75c.
Antimony, Asiatic	15.00c. to 16.00c.
Alum., virgin, 99 per cent plus	22.50c. to 24.00c.
Alum., No. 1 for remelting, 98 to 99 per cent	19.50c. to 21.00c.
Solder, ½ and ½	29.25c. to 30.25c.
Babbitt metal, commercial grade	20.25c. to 50.25c.

*These prices, which are also for delivery from Chicago and Cleveland warehouses, are quoted with the following percentages allowed off for extras: on copper sheets, 33 1/3; on brass sheets and rods, 40, and on brass and copper tubes, 35.

From Cleveland Warehouse

Delivered Prices per Lb.

Tin, Straits pig	49.25c.
Tin, bar	51.25c.
Copper, Lake	11.875c. to 12.125c.
Copper, electrolytic	11.875c. to 12.125c.
Copper, castings	11.625c.
Zinc, slabs	7.50c. to 7.75c.
Lead, American pig	5.60c. to 5.85c.
Lead, bar	8.75c.
Antimony, Asiatic	17.75c. to 18.00c.
Babbitt metal, medium grade	22.25c.
Babbitt metal, high grade	53.25c.
Solder, ½ and ½	29.50c.

Old Metals Per Lb., New York

Buying prices are paid by dealers for miscellaneous lots from smaller accumulators and selling prices are those charged to consumers after the metal has been prepared for their uses. (All prices are nominal.)

	Dealers' Buying Prices	Dealers' Selling Prices
Copper, hvy. crucible	8.375c.	9.125c.
Copper, hvy. and wire	7.375c.	7.875c.
Copper, light and bottoms	6.625c.	6.875c.
Brass, heavy	4.375c.	4.875c.
Brass, light	3.375c.	4.125c.
Hvy. machine composition	6.875c.	8.375c.
No. 1 yel. brass turnings	4.25c.	4.75c.
No. 1 red brass or compos. turnings	6.375c.	6.875c.
Lead, heavy	4.00c.	4.375c.
Cast aluminum	7.00c.	8.25c.
Sheet aluminum	11.50c.	13.00c.
Zinc	2.375c.	3.625c.

Lead

Practically every type of lead consumer is busy at the moment. September sales were remarkable, having been about 53,000 tons, the second largest month of the year. Much of the buying naturally was for forward consumption, and there has been so far in October a reaction as regards to new bookings. Nonetheless there is a remarkably good flow of spot business going through producers' offices, indicating increasing manufacturing orders among consumers. The price remains steady at 5.10c. a lb., New York, the high position of refined lead stocks (140,000 tons) offsetting somewhat a natural sympathetic bullishness arising from the activity of the copper market.

Zinc

Improved steel production has encouraged galvanizers to come into the market for additional spelter. Day-to-day sales are in comfortable volume, and consumers are only moderately covered for the remainer of the year. The price is quite strong at 4.95c. a lb., East St. Louis, there being a likelihood of higher quotations in sympathy with copper. Prime Western sales last week totaled just under 3000 tons, shipments were in the neighborhood of 4150 tons, and undelivered contracts now stand at 39,300 tons.

Tin

The war scare of several weeks ago influenced extremely active buying, and as this petered out there has been a tendency for buyers to reconvert stocks into money, the result being that, if anything, the market today has more sellers than buyers. Turnover in tin is currently very spotty and in poor volume, and price changes here arise entirely from manipulations in London, which point is very active despite poor buying volume in the United States, the largest single outlet for tin. Prices of Straits metal varied somewhat during the past week, the trend being upward to today's level of 44.875c. a lb. On first call in London this morning, turnover was quite brisk with prompt metal quoted at £206 5s., three-months metal at £207 5s., and with the Singapore market averaging near £210 10s.

FABRICATED STEEL

NORTH ATLANTIC STATES

AWARDS

7500 Tons, New York, Hunter College building, to Harris Structural Steel Co., Plainfield, N. J.

1900 Tons, New York, World's Fair building, Soviet Government, to Harris Structural Steel Co., Plainfield, N. J.

1285 Tons, Philadelphia, machine shop extension building No. 16, Navy Yard, to American Bridge Co., Pittsburgh; Ralph S. Herzog general contractor.

960 Tons, Philadelphia, Navy Yard storehouse, to Bethlehem Steel Co., Bethlehem, Pa.

650 Tons, Harrisburg, Pa., two apartment houses, to Bethlehem Steel Co., Bethlehem, Pa.

600 Tons, Brooklyn, extension crane runways, Navy Department, to American Bridge Co., Pittsburgh.

500 Tons, Brooklyn, public school No. 27, to Bethlehem Fabricators, Inc., Bethlehem, Pa.

310 Tons, New York, curb angles, to American Bridge Co., Pittsburgh.

260 Tons, New York, addition to telephone building, to Bethlehem Fabricators, Inc., Bethlehem, Pa.

229 Tons, Orange County, N. Y., State highway bridge, to American Bridge Co., Pittsburgh; John Arborio, Inc., general contractor.

225 Tons, Baltimore, addition to Women's Hospital, to Dietrich Brothers, Baltimore; Cummins Construction Co., general contractor.

215 Tons, Emeryville, N. Y., Central New York Power Corp., 67 transmission towers, to Lackawanna Steel Construction Corp., Buffalo.

192 Tons, Pittsburgh, Concord School, to Guibert Steel Co., Pittsburgh; S. M. Seisel Co., general contractor.

170 Tons, Little Falls, N. Y., Mohawk River bridge, to American Bridge Co., Pittsburgh.

165 Tons, Brooklyn, alterations to garage, F. & M. Schaefer Brewing Co., to Bethlehem Fabricators, Inc., Bethlehem, Pa.

140 Tons, Manhasset, N. Y., grade school, to Dreier Structural Steel Co., New York.

130 Tons, Corona, L. I., police station, to Lehigh Structural Steel Co., Allentown, Pa.

110 Tons, Chemung County, N. Y., State highway bridges FAS-SS-38-30, to American Bridge Co., Pittsburgh.

105 Tons, Chautauqua County, State highway bridge RC-3987, to Lackawanna Steel Construction Corp., Buffalo.

104 Tons, Elmira, N. Y., building for Sullivan Estate, to American Bridge Co., Pittsburgh.

100 Tons, Garden City, N. Y., St. Joseph's School, to Belmont Iron Works, Philadelphia.

100 Tons, Providence, R. I., power house, to Providence Steel & Iron Co., Providence; Tredennick Billings Co., contractor.

SOUTH AND SOUTHWEST

740 Tons, Chattanooga, Tenn., superstructure, Chickamauga power house for TVA, to American Bridge Co., Pittsburgh.

575 Tons, Denton County, Tex., bridge FAP-117-C, to North Texas Iron & Steel Co., Fort Worth, Tex.

510 Tons, Charleston, S. C., structural and machine shop extension, to Virginia Bridge Co., Roanoke, Va.

248 Tons, Maury County, Tenn., State highway bridge, to Decatur Iron & Steel Co., Decatur, Ala.; Hagen Construction Co., general contractor.

240 Tons, Conchos Dam, N. M., irrigation headworks, to Lakeside Bridge & Steel Co., Milwaukee, through G. C. McCarthy Improvement Co.

CENTRAL STATES

650 Tons, Detroit, Montgomery Ward Co. store building, to Whitehead & Kales, Detroit.

200 Tons, Cleveland, plant for Weldrods Corp., to Patterson-Leitch Co., Cleveland, through A. M. Higley Co.

165 Tons, Duluth, Minn., bridge No. 5592, to American Bridge Co.

160 Tons, Ida Grove, Iowa, State bridge WPGH-80, to Pittsburgh-Des Moines Steel Co., Pittsburgh.

150 Tons, Hastings, Minn., railroad bridge, to American Bridge Co.

140 Tons, Toledo, Ohio and Marcus Hook, Pa., control houses for Sun Oil Co., to Bethlehem Steel Co., Bethlehem, Pa.

130 Tons, Anthon, Iowa, State bridge T-120, to Pittsburgh-Des Moines Steel Co., Pittsburgh.

120 Tons, Curzons, Mo., bridge, to Joseph T. Ryerson & Son, Inc., Chicago.

112 Tons, Winona, Minn., grain elevator, to Gage Structural Steel Co., Chicago, through Burrell Engineering & Construction Co.

110 Tons, Portage, Wis., high school building, to C. Hennecke Co., Milwaukee.

WESTERN STATES

750 Tons, Bremerton, Wash., smith shop and pipe shop additions, Navy Yard, to American Bridge Co., Pittsburgh.

686 Tons, Santa Ana, Cal., Santa Fe railroad bridge for Prado Dam track relocation, to American Bridge Co., Pittsburgh.

102 Tons, Ben Ali, Cal., State undercrossing, to Ingalls Iron Works Co., San Francisco.

STRUCTURAL STEEL PROJECTS

NORTH ATLANTIC STATES

4000 Tons, Philadelphia, Navy Yard turret shop and structural assembly shop; bids due Oct. 26.

1700 Tons, New York, addition to hospital buildings, United States Veterans Administration.

1200 Tons, New York, reconstruction roadways, Williamsburg bridge, cont. No. 1.

600 Tons, Kew Gardens, N. Y., Briarwood Gardens housing project.

315 Tons, Steuben County, N. Y., State highway bridges.

300 Tons, Bradford, Pa., school and gymnasium; Benziner Co., Jamestown, N. Y., low bidder.

230 Tons, Jersey City, N. J., Tonnele Avenue highway bridge; bids Oct. 29.

230 Tons, Bridgeport, Conn., Bridgeport Brass Co. building.

225 Tons, Clinton, N. Y., gymnasium building, Hamilton College.

215 Tons, Abington, Mass., school building.

200 Tons, Pittsburgh, addition to Holmes School.

180 Tons, Bradford County, Pa., State highway maintenance building.

175 Tons, Abington, Mass., two schools.

150 Tons, Mayville, N. Y., school; bids close Oct. 22.

135 Tons, Corona, N. Y., station house, United States Treasury Department.

125 Tons, Cambridge, Md., bridge over Cambridge Creek.

100 Tons, Buffalo, hangar; bids due at Buffalo City Hall, Oct. 11.

100 Tons, Gardner, Mass., City Hall; Swanburg Construction Co., Manchester, N. H., contractor.

100 Tons, Pepperell, Mass., high school; Thomas A. Cassidy Co., Cambridge, Mass., contractor.

SOUTH AND SOUTHWEST

450 Tons, Charleston, W. Va., Provident building.

200 Tons, Louisville, Ky., bridges, Louisville & Nashville Railroad Co.

103 Tons, Newkirk, N. M., bridge on Rio Grande Division of Southern Pacific Co.

CENTRAL STATES

7500 Tons, Indiana Harbor, Ind., strip mill group and open-hearth extension group, Youngstown Sheet & Tube Co.

3500 Tons, Arkalon, Kan., railroad bridge over Cimarron River.

400 Tons, Detroit, County bridge.

400 Tons, Alpena, Mich., bridge; bids Oct. 14.

360 Tons, Clark and Green Counties, Ohio, State bridge; Midland Construction Co., Columbus, Ohio, low bidder.

270 Tons, Minneapolis, State bridge No. 5860.

215 Tons, Millville, Minn., State bridge No. 5506.

210 Tons, Monroe, Wis., high school.

180 Tons, Detroit, building for Boys Club.

150 Tons, Cleveland, for Brewing Corp. of America.

125 Tons, Alpena, Mich., addition to State hospital.

120 Tons, Ypsilanti, Mich., addition to State hospital; bids in.

WESTERN STATES

3000 to 4000 Tons, Mare Island, Cal., Navy yard machine shop; bids soon.

275 Tons, Salt Lake City, tunnel supports for Provo River project (Invitation 808); bids Oct. 27.

170 Tons, Bonneville, Ore., stop logs for Bonneville Dam.

HAWAII

2555 Tons, shapes and sheet piling, Honolulu; bids Oct. 20 by United States Engineer.

FABRICATED PLATES

AWARDS

Unstated tonnage, United States Engineer's Office, Pittsburgh, Pa., eight units of hoisting machinery for Federal Water Control project, State of Pennsylvania, to Lakeside Bridge & Steel Co., Milwaukee.

NEW PROJECTS

307 Tons, Sacramento, Cal., water pipe.

250 Tons, Newburyport, Mass., standpipe.

200 Tons, Webster, Mass., standpipe.

150 Tons, Foxboro, Mass., standpipe.

SHEET PILING

NEW PROJECTS

1000 Tons, Columbus, Ohio, H-piling for WPA at Gordon Park, Cleveland; Republic Structural Steel Co., Cleveland, low bidder.

Unstated tonnage, Alpena, Mich., bridge; bids Oct. 14.

IRON AND STEEL SCRAP

. . . Composite unchanged at $14.25 for third week . . . Mill buying not in sufficient volume to test present prices

OCT. 11.—In general, the market undertone is strong, but untested. Only one mill has been buying in the Chicago district, for example, and in eastern Pennsylvania the only material moving is on old orders. What sales have been made at Pittsburgh have been made in line with quoted prices. No. 1 steel has been unchanged in price range there now for six weeks. THE IRON AGE composite price of No. 1 heavy melting remains at $14.25 for the third week. Railroad items have sold off somewhat from September figures at St. Louis and Cleveland, and some railroad specialties are down at Pittsburgh, although railroad heavy melting steel has been sold to mills within the previously quoted range. No changes have been made in Detroit prices, but a reduction in hydraulic bundles appears imminent:

Material for export has been coming out a little more freely along the coast and no change in prices has been necessary for some time.

Pittsburgh

The undertone continues strong, with sales of No. 1 steel having been made into consumption during the past week at $15.50 a ton. This grade remains quotable at $15 to $15.50. The recent railroad list has clarified railroad heavy melting steel with sales having been made into consumption within the quoted range of $15.75 to $16.25 for this grade. The market appears to be well balanced between buying and selling and would be sensitive to large tonnage requirements.

Chicago

Dealers and brokers are trading on the basis of $12.75 and $13 for heavy melting steel, but for the time being this quotation remains at $12.50 to $13, the latter figure representing the last mill sale in this area. It is not believed that a sale can be made today at $13, and a railroad is said to have rejected $13.75 gross last week. There is only one major buyer here, but some reports have been heard lately that another mill might be considering a purchase in view of depleted stocks and increasing operations.

Philadelphia

The situation here is somewhat listless, with some support arising from continued export activity, but with brokers and dealers as a group inclined to withhold strong action until domestic outlets assume more importance. At present, spotty shipments of important grades are going into practically all district mills on old orders, but nothing definite in the way of new business has transpired since a nominal $15 order for No. 1 steel reported a week ago. At Port Richmond, two brokers are making up a cargo, supposedly for Italy, and another boat is expected before the month's end. The entire price list is for the most part untested, nominally unchanged from last week, but bolstered to some extent by a strong undertone.

Cleveland

No. 1 heavy melting remains at $12.50 to $13 per ton as during the past several weeks. It is understood railroad scrap on the recent monthly closings was down slightly from the September figures, but insufficient to affect published quotations to any great extent. As usual, some items went for export.

Youngstown

Heartened by the jump in the national ingot output, dealers here are holding onto their scrap closely. No. 1 heavy melting at $14 to $14.50 per ton is unchanged this week.

Buffalo

The scrap situation remains materially the same this week but with a noticeable improvement in spirit in many quarters. Outside of small lots, no sales have been made. The market maintains its strength, however, and many dealers feel that, with ingot production continuing at its present rate, it will not be very long before substantial tonnages will move.

St. Louis

Scrap iron prices are down from 25c. to $1 a ton, the softer market being the result of lack of buying by mills and heavier movement of material to this market. This weakness is regarded as temporary by dealers who expect the market to right itself within the next few weeks. Railroad list: Missouri-Pacific, 1600 tons.

Cincinnati

The scrap market is without feature. Some sheet clippings and reworked No. 2 steel are moving on contract, but new business is nil. Prices are unchanged as dealers are wary of carrying too heavy inventories.

Detroit

There appears to have been enough recent buying of hydraulic compressed sheets to sustain, for the time being, the quoted dealers' buying prices. However, it is rumored that a general reduction is in the offing. This rumor seems to be in line with an underlying weakness attributable largely to the slow movement of scrap locally. The opinion that prices are out of line with those in other centers lends credence to the current talk that downward adjustments are overdue.

(Note: Through an oversight, long turnings were not marked down 50c. last week in line with reductions in related blast furnace grades. Correction has been made this week.)

New York

Prices for material on cars for domestic shipment are unchanged, in line with the static condition of delivered prices in eastern Pennsylvania. Buying prices for export scrap are also unchanged, for the 11th consecutive week, incidentally. No new export orders are reported, but it is not unlikely that additional supplies will be sought in the not too distant future by the two member countries of the scrap cartel that figured in the last order, namely Germany and Italy. Great Britain, the largest of European consumers last year, is a minor factor at present.

Boston

With transportation facilities materially restored, following hurricane, flood and tidal wave disruption, the export market is looking up. A boat is loading here this week, and another at Providence. These loadings will be completed before Oct. 20, when duplicate loadings are anticipated. Export prices are steady and unchanged. In the domestic market little business was transacted the past week, but currently is gathering momentum. Bundled skeleton has been reduced 50c. to $7 to $7.25 a ton, f.o.b., but prices otherwise have not changed.

TRADE NOTES

The Whitin Machine Works, Whitinsville, Mass., has acquired the United States Textile Machine Co., Scranton, Pa., manufacturer of throwing machinery for the silk and rayon industries.

Roots-Connersville Blower Corp., Connersville, Ind., has appointed as additional sales representatives W. J. Brown, Charleston, W. Va., and Hiram H. Haight, Milwaukee.

William Sellers & Co., Inc., Philadelphia, since 1848 makers of machine tools, have engaged Clarke-Harrison, Inc., management engineers, to take charge of all the company's operations. A program involving improvement in planer design and construction is to be announced on or before Nov. 1.

R. S. Products Corp., manufacturing engineers, Philadelphia, has appointed the Beeman Combustion Supply Co., 2970 West Grand Boulevard, Detroit, as representative in the Detroit territory.

Pioneer Engineering & Mfg. Co., 31 Melbourne Avenue, Detroit, manufacturer of Rollway positive displacement and Pioneer impeller type coolant and lubricant pumps, has appointed Harris Pump & Supply Co., 320 Boulevard of the Allies, Pittsburgh, as representative in western Pennsylvania and northern West Virginia.

Iron and Steel Scrap Prices

PITTSBURGH

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel	$15.00 to $15.50
Railroad hvy. mltng.	15.75 to 16.25
No. 2 hvy. mltng. steel	13.75 to 14.25
Scrap rails	16.50 to 17.00
Rails 3 ft. and under	17.00 to 17.50
Comp. sheet steel	15.00 to 15.50
Hand bundled sheets	14.00 to 14.50
Hvy. steel axle turn.	13.75 to 14.25
Machine shop turn.	9.50 to 10.00
Short shov. turn.	9.50 to 10.00
Mixed bor. & turn.	8.25 to 8.75
Cast iron borings	8.25 to 8.75
Cast iron carwheels	14.50 to 15.00
Hvy. breakable cast	12.50 to 13.00
No. 1 cupola cast	15.25 to 15.75
RRfl knuckles & cplrs.	16.50 to 17.00
Rail coil & leaf springs	16.50 to 17.00
Rolled steel wheels	16.50 to 17.00
Low phos. billet crops	17.50 to 18.00
Low phos. punchings	16.00 to 16.50
Low phos. plate	16.00 to 16.50

PHILADELPHIA

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel	$14.50 to $15.00
No. 2 hvy. mltng. steel	13.00 to 13.50
Hydraulic bund., new	14.50 to 15.00
Hydraulic bund., old	11.50 to 12.00
Steel rails for rolling	17.00 to 17.50
Cast iron carwheels	16.50 to 17.00
Hvy. breakable cast	16.00 to 16.50
No. 1 cast	16.50 to 17.00
Stove plate (steel wks.)	13.00 to 13.50
Railroad malleable	15.50 to 16.00
Machine shop turn.	8.00 to 8.50
No. 1 blast furnace	6.50 to 7.00
Cast borings	6.50 to 7.00
Heavy axle turnings	10.00 to 10.50
No. 1 low phos. hvy.	16.50 to 17.00
Couplers & knuckles	16.50 to 17.00
Rolled steel wheels	16.50 to 17.00
Steel axles	21.50 to 22.00
Shafting	19.50 to 20.00
No. 1 RR. wrought	15.00 to 15.50
Spec. iron & steel pipe	12.00 to 12.50
No. 1 forge fire	11.00 to 11.50
Cast borings (chem.)	9.50 to 10.00

CHICAGO

Delivered to Chicago district consumers:

	Per Gross Ton
Hvy. mltng. steel	$12.50 to $13.00
Auto. hvy. mltng. steel alloy free	11.00 to 11.50
No. 2 auto. steel	10.50 to 11.00
Shoveling steel	12.50 to 13.00
Factory bundles	11.50 to 12.00
Dealers' bundles	11.00 to 11.50
Drop forge flashings	10.50 to 11.00
No. 1 busheling	11.50 to 12.00
No. 2 busheling, old	4.25 to 4.75
Rolled carwheels	15.00 to 15.50
Railroad tires, cut	15.50 to 16.00
Railroad leaf springs	15.50 to 16.00
Steel coup. & knuckles	14.00 to 14.50
Axle turnings	11.50 to 12.00
Coil springs	16.00 to 16.50
Axle turn. (elec.)	12.00 to 12.50
Low phos. punchings	15.50 to 16.00
Low phos. plates 12 in. and under	15.50 to 16.00
Cast iron borings	5.50 to 6.00
Short shov. turn.	6.50 to 7.00
Machine shop turn.	5.50 to 6.00
Rerolling rails	17.00 to 17.50
Steel rails under 3 ft.	15.50 to 16.00
Steel rails under 2 ft.	16.00 to 16.50
Angle bars, steel	15.00 to 15.50
Cast iron carwheels	13.00 to 13.50
Railroad malleable	14.00 to 14.50
Agric. malleable	10.00 to 10.50
	Per Net Ton
Iron car axles	18.00 to 18.50
Steel car axles	18.50 to 19.00
Locomotive tires	15.50 to 16.00
Pipes and flues	8.50 to 9.00
No. 1 machinery cast	12.00 to 12.50
Clean auto. cast	11.50 to 12.00
No. 1 railroad cast	11.00 to 11.50
No. 1 agric. cast	10.50 to 11.00
Stove plate	8.50 to 9.00
Grate bars	8.50 to 9.00
Brake shoes	9.50 to 10.00

YOUNGSTOWN

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel	$14.00 to $14.50
No. 2 hvy. mltng. steel	13.00 to 13.50
Low phos. plate	14.50 to 15.00
No. 1 busheling	13.00 to 13.50
Hydraulic bundles	13.50 to 14.00
Machine shop turn.	9.50 to 10.00

CLEVELAND

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel	$12.50 to $13.00
No. 2 hvy. mltng. steel	11.50 to 12.00
Comp. sheet steel	12.00 to 12.50
Light bund. stampings	9.00 to 9.50
Drop forge flashings	10.00 to 10.50
Machine shop turn.	7.00 to 7.50
Short shov. turn.	7.50 to 8.00
No. 1 busheling	11.00 to 11.50
Steel axle turnings	10.00 to 10.50
Low phos. billet and bloom crops	17.00 to 17.50
Cast iron borings	7.75 to 8.25
Mixed bor. & turn.	7.75 to 8.25
No. 2 busheling	7.75 to 8.25
No. 1 cast	16.50 to 17.00
Railroad grate bars	9.50 to 10.00
Stove plate	10.00 to 10.50
Rails under 3 ft.	18.50 to 19.00
Rails for rolling	17.00 to 17.50
Railroad malleable	15.00 to 15.50
Cast iron carwheels	14.00 to 14.50

BUFFALO

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel	$14.00 to $14.50
No. 2 hvy. mltng. steel	12.00 to 12.50
Scrap rails	15.00 to 15.50
New hvy. bndled sheets	12.00 to 12.50
Old hydraul. bundles	10.50 to 11.00
Drop forge flashings	12.00 to 12.50
No. 1 busheling	12.00 to 12.50
Hvy. axle turnings	10.50 to 11.00
Machine shop turn.	6.75 to 7.25
Knuckles & couplers	16.50 to 17.00
Coil & leaf springs	16.50 to 17.00
Rolled steel wheels	16.00 to 16.50
Low phos. billet crops	15.50 to 16.00
Shov. turnings	6.75 to 7.25
Mixed bor. & turn.	6.75 to 7.25
Cast iron borings	6.50 to 7.00
Steel car axles	16.50 to 17.00
No. 1 machinery cast	15.50 to 16.00
No. 1 cupola cast	14.50 to 15.00
Stove plate	13.00 to 13.50
Steel rails under 3 ft.	17.50 to 18.00
Cast iron carwheels	13.50 to 14.00
Railroad malleable	14.50 to 15.00
Chemical borings	8.50 to 9.00

ST. LOUIS

Dealers' buying prices per gross ton delivered to consumer:

Selected hvy. melting	$12.50 to $13.00
No. 1 hvy. melting	12.50 to 13.00
No. 2 hvy. melting	12.00 to 12.50
No. 1 locomotive tires	14.00 to 14.50
Misc. stand. sec. rails	14.00 to 14.50
Railroad springs	14.50 to 15.50
Bundled sheets	7.50 to 8.00
No. 1 busheling	7.50 to 8.00
Cast. bor. & turn.	3.75 to 4.25
Machine shop turn.	4.00 to 4.50
Heavy turnings	9.00 to 9.50
Rails for rolling	16.50 to 17.00
Steel car axles	18.50 to 19.00
No. 1 RR. wrought	10.75 to 11.25
No. 2 RR. wrought	12.00 to 12.50
Steel rails under 3 ft.	15.50 to 16.00
Steel angle bars	13.50 to 14.00
Cast iron carwheels	13.75 to 14.25
No. 1 machinery cast	14.00 to 14.50
Railroad malleable	12.00 to 12.50
No. 1 railroad cast	11.00 to 11.50
Stove plate	9.00 to 9.50
Grate bars	8.50 to 9.00
Brake shoes	9.50 to 10.00

CINCINNATI

Dealers' buying prices per gross ton at yards:

No. 1 hvy. mltng. steel	$11.00 to $11.50
No. 2 hvy. mltng. steel	8.75 to 9.50
Scrap rails for mltng.	15.00 to 15.50
Loose sheet clippings	6.50 to 7.00
Hydrau. b'ndled sheets	10.00 to 10.50
Cast iron borings	3.00 to 3.50
Machine shop turn.	4.25 to 4.75
No. 1 busheling	7.75 to 8.25
No. 2 busheling	2.50 to 3.00
Rails for rolling	17.00 to 17.50
No. 1 locomotive tires	13.75 to 14.25
Short rails	17.50 to 18.00
Cast iron carwheels	12.25 to 12.75
No. 1 machinery cast	11.75 to 12.25
No. 1 railroad cast	10.75 to 11.25
Burnt cast	6.75 to 7.25
Stove plate	6.75 to 7.25
Agricul. malleable	11.25 to 11.75
Railroad malleable	13.75 to 14.25
Mixed hvy. cast.	9.25 to 9.75

BIRMINGHAM

Per gross ton delivered to consumer:

Hvy. melting steel	$12.50 to $14.00
Scrap steel rails	14.50 to 15.00
Short shov. turnings	7.50 to 8.10
Stove plate	9.00 to 10.00
Steel axles	15.00 to 16.00
Iron axles	15.00 to 16.00
No. 1 RR. wrought	.... 10.00
Rails for rolling	16.00 to 16.50
No. 1 cast	.... 14.50
Tramcar wheels	.... 14.00

DETROIT

Dealers' buying prices per gross ton:

No. 1 hvy. mltng. steel	$10.00 to $10.50
No. 2 hvy. mltng. steel	8.50 to 9.00
Borings and turnings	5.50 to 6.00
Long turnings	5.50 to 6.00
Short shov. turnings	6.50 to 7.00
No. 1 machinery cast	11.50 to 12.00
Automotive cast	12.50 to 13.00
Hvy. breakable cast	9.00 to 9.50
Hydraul. comp. sheets	12.25 to 12.75
Stove plate	8.00 to 8.50
New factory bushel	11.00 to 11.50
Old No. 2 busheling	3.00 to 3.50
Sheet clippings	9.00 to 9.50
Flashings	9.00 to 9.50
Low phos. plate scrap	11.75 to 12.25

NEW YORK

Dealers' buying prices per gross ton on cars:

No. 1 hvy. mltng. steel	$10.00 to $10.50
No. 2 hvy. mltng. steel	8.50 to 9.00
Hvy. breakable cast	12.00 to 12.50
No. 1 machinery cast	12.00 to 12.50
No. 2 cast	9.50 to 10.00
Stove plate	9.00 to 9.50
Steel car axles	20.00 to 20.50
Shafting	15.00 to 15.50
No. 1 RR. wrought	11.00 to 11.50
No. 1 wrought long	9.50 to 10.00
Spec. iron & steel pipe	8.50 to 9.00
Rails for rolling	16.00 to 16.50
Clean steel turnings*	3.50 to 4.00
Cast borings*	3.00 to 3.50
No. 1 blast furnace	3.00 to 3.50
Cast borings (chem.)	9.50 to 10.00
Unprepared yard scrap	5.00 to 5.50
Light iron	3.00 to 3.50
Per gross ton, delivered local foundries:	
No. 1 machn. cast†	$13.50 to $14.00
No. 2 cast†	10.50 to 11.00

* $1.50 less for truck loads.
† Northern N. J. prices are $2 to $2.50 higher

BOSTON

Dealers' buying prices per gross ton:

No. 1 hvy. mltng. steel	Nominal
Scrap rails	Nominal
No. 2 steel	Nominal
Breakable cast	$10.75 to $11.00
Machine shop turn.	.... 3.38
Mixed bor. & turn.	2.00 to 2.25
Bun. skeleton long	7.00 to 7.25
Shafting	10.25 to 10.50
Cast bor. chemical	5.50 to 5.75
Per gross ton delivered consumers' yards:	
Textile cast	$14.50 to $15.00
No. 1 machine cast	14.00 to 14.50

PACIFIC COAST

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel	$12.50 to $14.00
No. 2 hvy. mltng. steel	11.50 to 13.00

CANADA

Dealers' buying prices at their yards, per gross ton:

	Toronto	Montreal
No. 1 hvy. mltng. steel	$9.50	$9.00
No. 2 hvy. mltng. steel	8.00	7.50
Mixed dealers steel	7.00	6.50
Scrap pipe	5.50	5.00
Steel turnings	4.50	4.00
Cast borings	3.50	3.00
Machinery cast	15.00	14.00
Dealers cast	13.00	12.00
Stove plate	11.00	10.50

EXPORT

Dealers' buying prices per gross ton:

New York, truck lots, delivered, barges

No. 1 hvy. mltng. steel	$11.00 to $11.50
No. 2 hvy. mltng. steel	9.50 to 10.00
No. 2 cast	10.00 to 11.00
Stove plate	9.00 to 10.00

Boston on cars at Army Base or Mystic Wharf

No. 1 hvy. mltng. steel	$12.50 to $13.00
No. 2 hvy. mltng. steel	11.50 to 12.00
Rails (scrap)	12.50 to 13.00

Philadelphia, delivered alongside boats, Port Richmond

No. 1 hvy. mltng. steel	Nominal
No. 2 hvy. mltng. steel	Nominal

PRICES ON FINISHED AND SEMI-FINISHED IRON AND STEEL

SEMI-FINISHED STEEL

Billets, Blooms and Slabs

Pittsburgh, Chicago, Gary, Cleveland, Youngstown, Buffalo, Birmingham, Sparrows Point (Rerolling only). Prices delivered Detroit are $2 higher. F.o.b. Duluth, billets only, $2 higher.

	Per Gross Ton
Rerolling	$34.00
Forging quality	40.00

Sheet Bars

Pittsburgh, Chicago, Cleveland, Youngstown, Buffalo, Canton, Sparrows Point, Md.

	Per Gross Ton
Open-hearth or bessemer	$34.00

Skelp

Pittsburgh, Chicago, Youngstown, Coatesville, Pa., Sparrows Point, Md.

	Per Lb.
Grooved, universal and sheared	1.90c.

Wire Rods

(No. 5 to 9/32 in.).

	Per Gross Ton
Pittsburgh, Chicago or Cleveland	$43.00
Worcester, Mass.	45.00
Birmingham	43.00
San Francisco	52.00

Rods over 9/32 in. or 47/64 in., inclusive, $5 a ton over base.

SOFT STEEL BARS

	Base per Lb.
Pittsburgh, Chicago, Gary, Cleveland, Buffalo and Birmingham	2.25c.
Detroit, delivered	2.35c.
Duluth	2.35c.
Philadelphia delivered	2.57c.
New York	2.59c.
On cars dock Gulf ports	2.60c.
On cars dock Pacific ports	2.85c.

RAIL STEEL BARS

(For merchant trade)

Pittsburgh, Chicago, Gary, Cleveland, Buffalo, Birmingham	2.10c.
On cars dock Tex. Gulf ports	2.45c.
On cars dock Pacific ports	2.70c.

BILLET STEEL REINFORCING BARS

(Straight lengths as quoted by distributers)

Pittsburgh, Chicago, Gary, Birmingham, Buffalo, Cleveland, Youngstown or Sparrows Pt.	1.90c. to 2.05c.
Detroit, delivered	2.00c. to 2.15c.
On cars dock Tex. Gulf ports	2.25c. to 2.40c.
On cars dock Pacific ports	2.50c.

RAIL STEEL REINFORCING BARS

(Straight lengths as quoted by distributers)

Pittsburgh, Chicago, Gary, Buffalo, Cleveland, Youngstown or Birmingham	1.75c. to 1.90c.
Detroit, delivered	1.85c. to 2.00c.
On cars dock Tex. Gulf ports	2.10c. to 2.25c.
On cars dock Pacific ports	2.35c.

The above range in prices covers generally the spread between large and small jobs.

IRON BARS

Chicago and Terre Haute	2.15c.
Pittsburgh (refined)	3.60c.

COLD FINISHED BARS AND SHAFTING*

	Base per Lb.
Pittsburgh, Buffalo, Cleveland, Chicago and Gary	2.70c.
Detroit	2.75c.

* In quantities of 10,000 to 19,999 lb.

PLATES

	Base per Lb.
Pittsburgh, Chicago, Gary, Birmingham, Sparrows Point, Cleveland, Youngstown, Coatesville, Claymont, Del.	2.10c.
*Philadelphia, del'd	2.15c.
*New York, del'd	2.29c.
On cars dock Gulf ports	2.45c.
On cars dock Pacific ports	2.60c.
Wrought iron plates, P't'g	3.80c.

*Eastern prices subject to occasional concessions of $2 a ton.

FLOOR PLATES

Pittsburgh or Chicago	3.35c.
New York, del'd	3.71c.
On cars dock Gulf ports	3.70c.
On cars dock Pacific ports	3.95c.

STRUCTURAL SHAPES

	Base per Lb.
Pittsburgh, Chicago, Gary, Buffalo, Bethlehem or Birmingham	2.10c
Philadelphia, del'd	2.215c.
New York, del'd	2.27c.
On cars dock Gulf ports	2.45c.
On cars dock Pacific ports	2.70c.

STEEL SHEET PILING

	Base per Lb.
Pittsburgh, Chicago or Buffalo	2.40c.
On cars dock Gulf ports	2.85c.
On cars dock Pacific ports	2.90c.

RAILS AND TRACK SUPPLIES

F.o.b. Mill

Standard rails, heavier than 60 lb., per gross ton	$40.00
Angle bars, per 100 lb	2.70

F.o.b. Basing Points

Light rails (from billets) per gross ton	$40.00
Light rails (from rail steel) per gross ton	39.00

	Base per Lb.
Cut spikes	3.00c.
Screw spikes	4.55c.
Tie plates, steel	2.15c.
Tie plates, Pacific Coast ports	2.25c.
Track bolts, to steam railroads	4.15c.
Track bolts, to jobbers, all sizes (per 100 counts)	65-5

Basing points on light rails are Pittsburgh, Chicago and Birmingham; on spikes and tie plates, Pittsburgh, Chicago, Portsmouth, Ohio, Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., Birmingham and Pacific Coast ports; on tie plates alone, Steelton, Pa., Buffalo; on spikes alone, Youngstown, Lebanon, Pa., Richmond, Va.

SHEETS

PRICES F.O.B. UNLESS OTHERWISE NOTED

Hot Rolled

	Base per Lb.
Pittsburgh, Gary, Birmingham, Buffalo, Sparrows Point, Cleveland, Youngstown, Middletown or Chicago	1.95c.
Detroit, delivered	2.05c.
Philadelphia, delivered	2.12c.
Granite City	2.05c.
On cars dock Pacific ports	2.65c.
Wrought iron, Pittsburgh	4.25c.

Cold Rolled*

Pittsburgh, Gary, Buffalo, Youngstown, Cleveland, Middletown or Chicago	3.00c.
Detroit, delivered	3.10c.
Granite City	3.10c.
Philadelphia, delivered	3.32c.
On cars dock Pacific ports	3.80c.

* Mill run sheets are 10c. per 100 lb. less than base; and primes only, 25c. above base.

Galvanized Sheets, 24 Gage

Pittsburgh, Chicago, Gary, Sparrows Point, Buffalo, Middletown, Youngstown or Birmingham	3.50c.
Philadelphia, delv'd	3.67c.
Granite City	3.60c.
On cars dock Pacific ports	4.00c.
Wrought iron, Pittsburgh	6.10c.

Electrical Sheets

(*F.o.b. Pittsburgh*)

	Base per Lb.
Field grade	3.20c.
Armature	3.55c.
Electrical	4.05c.
Special Motor	4.95c.
Special Dynamo	5.65c.
Transformer	6.15c.
Transformer Special	7.15c.
Transformer Extra Special	7.65c.

Silicon Strip in coils—Sheet price plus silicon sheet extra width extras plus 25c. per 100 lb. for coils. Pacific ports add 70c. a 100 lb.

Long Ternes

No. 24 unassorted 8-lb. coating f.o.b. Pittsburgh or Gary	3.75c.
F.o.b. cars dock Pacific ports	4.65c.

Vitreous Enameling Stock, 20 Gage

Pittsburgh, Chicago, Gary, Youngstown, Middletown or Cleveland	3.15c.
Detroit, delv'd	3.25c.
Granite City	3.25c.
On cars dock Pacific ports	3.95c.

TIN MILL PRODUCTS

Black Plate

Pittsburgh, Chicago and Gary	3.15c.
Granite City	3.25c.
On cars dock Pacific ports, boxed	4.10c.

NOTE: No. 29 gage is heaviest in which tin mill black plate is sold. No. 28 and heavier taking sheet base. There are no gages which take the above base prices as extras are applicable in all cases.

Tin Plate

	Per Base Box
Standard cokes, Pittsburgh, Chicago and Gary	$5.35
Standard cokes, Granite City	5.45

Special Coated Manufacturing Ternes

	Per Base Box
Pittsburgh	$4.65
Gary	4.65
Granite City	4.75

Roofing Terne Plate

(*F.o.b. Pittsburgh*)

(Per Package, 112 sheets, 20 x 28 in.)

8-lb. coating I.C.	$12.00
15-lb. coating I.C.	14.00
20-lb. coating I.C.	15.00
25-lb. coating I.C.	16.00
30-lb. coating I.C.	17.25
40-lb. coating I.C.	19.50

HOT ROLLED STRIP

Prices F.o.b. Unless Otherwise Noted

(*Widths up to 12 in.*)

	Base per Lb
Pittsburgh, Chicago, Gary, Cleveland, Middletown, Youngstown or Birmingham	1.95c.
Detroit, delivered	2.05c.

Cooperage Stock

Pittsburgh & Chicago	2.25c.

COLD ROLLED STRIP*

	Base per Lb.
Pittsburgh, Youngstown or Cleveland	2.95c.
Chicago	3.05c.
Detroit, delivered	3.05c.
Worcester	3.15c.

* Carbon 0.25 and less.

Commodity Cold Rolled Strip

Pittsburgh, Youngstown or Cleveland	3.10c.
Detroit, delivered	3.20c.
Worcester	3.50c.

COLD ROLLED SPRING STEEL

		Pittsburgh and Cleveland	Worcester
Carbon	0.26-0.50%	2.95c.	3.15c.
Carbon	.51- .75	4.30c.	4.50c.
Carbon	.76-1.00	6.15c.	6.35c.
Carbon	1.01 to 1.25	8.35c.	8.55c.

WIRE PRODUCTS

(Carload lots, f.o.b. Pittsburgh, Chicago, Cleveland and Birmingham)

To Manufacturing Trade

	Per Lb.
Bright wire	2.60c.
Galvanized wire, base	2.65c.*
Spring wire	3.20c.

*On galvanized wire to manufacturing trade, size and galvanizing extras are charged, the price Nos. 6 to 9 gage, inclusive, thus being 3.15c.

To the Trade

	Base per Keg
Standard wire nails	$2.45
Coated nails	2.45
Cut nails, carloads	3.60

	Base per 100 Lb.
Annealed fence wire	$2.95
Galvanized fence wire	3.35
Polished staples	3.15
Galvanized staples	3.40
Barbed wire, galvanized	3.20
Twisted barbless wire	3.20
Woven wire fence, base column.	67
Single loop bale ties, base col...	56

Note: Birmingham base same on above items, except spring wire.

Add $4 a ton for Mobile, Ala.; $5 for New Orleans; $6 for Lake Charles to above bases, except on galvanized and annealed merchant fence wire, which are $1 a ton additional in each case.

STEEL AND WROUGHT IRON PIPE AND TUBING

Welded Pipe

Base Discounts, f.o.b. Pittsburgh District and Lorain, Ohio, Mills

F.o.b. Pittsburgh only on wrought iron pipe.

Butt Weld

Steel In.	Black	Galv.	*Wrought Iron* In.	Black	Galv.
⅛	.56	36	⅛ & ¼	+ 9	+30
¼ to ⅜	.59	43½	½	24	6½
½	63½	54	¾	30	13
¾	66½	58	1 & 1¼	34	19
1 to 3	68½	60½	1½	38	21½
			2	37½	21

Lap Weld

2	61	52½	2	30½	15
2½ & 3	64	55½	2½ to 3½	31½	17½
3½ to 6	66	57½	4	33½	21
7 & 8	65	55½	4½ to 8.	32½	20
9 & 10	64½	55	9 to 12	28½	15
11 & 12	63½	54			

Butt Weld, extra strong, plain ends

⅛	54½	41½	¼ & ⅜	+10	+43
½ to ⅜	56½	45½	½	25	9
½	61½	53½	¾	31	15
¼	65½	57½	1 to 2	38	22½
1 to 3	67	60			

Lap Weld, extra strong, plain ends

2	59	51½	2	33½	18½
2½ & 3	63	55½	2½ to 4.	39	25½
3½ to 6	66½	59	4½ to 6.	37½	24
7 & 8	65½	56	7 & 8	38½	24½
9 & 10	64½	55	9 to 12	32	20½
11 & 12	63½	54			

On butt weld and lap weld steel pipe jobbers are granted a discount of 5%. On less-than-carload shipments prices are determined by adding 25 and 30% and the carload freight rate to the base card.

F.o.b. Gary prices are two points lower discount or $4 a ton higher than Pittsburgh or Lorain on lap weld and one point lower discount, or $2 a ton higher, on all butt weld 3 in. and smaller.

Boiler Tubes

Seamless Steel and Lap Weld Commercial Boiler Tubes and Locomotive Tubes. Minimum Wall.

(Net base prices per 100 ft. f.o.b. Pittsburgh in carload lots)

	Seamless Cold Drawn	Seamless Hot Rolled	Lap Weld Hot Rolled
1 in. o.d.....13 B.W.G.	$ 9.01	$ 7.82	....
1¼ in. o.d...13 B.W.G.	10.67	9.26	....
1½ in. o.d...13 B.W.G.	11.79	10.23	9.72
1¾ in. o.d...13 B.W.G.	13.42	11.64	11.06
2 in. o.d.....13 B.W.G.	15.03	13.04	12.38
2¼ in. o.d...13 B.W.G.	16.76	14.54	13.79
2¾ in. o.d...12 B.W.G.	18.45	16.01	15.16
2½ in. o.d...12 B.W.G.	20.21	17.54	16.58
2¾ in. o.d...12 B.W.G.	21.42	18.59	17.54
3 in. o.d.....12 B.W.G.	22.48	19.50	18.35
3½ in. o.d...11 B.W.G.	28.37	24.62	23.15
4 in. o.d.....10 B.W.G.	35.20	30.54	28.66
4½ in. o.d...10 B.W.G.	43.04	37.35	35.22
5 in. o.d..... 9 B.W.G.	54.01	46.87	44.25
6 in. o.d..... 7 B.W.G.	82.93	71.96	68.14

Extras for less carload quantities:

40,000 lb. or ft. or over	Base
30,000 lb. or ft. to 39,999 lb. or ft.	5%
20,000 lb. or ft. to 29,999 lb. or ft.	10%
10,000 lb. or ft. to 19,999 lb. or ft.	20%
5,000 lb. or ft. to 9,999 lb. or ft.	30%
2,000 lb. or ft. to 4,999 lb. or ft.	45%
Under 2,000 lb. or ft.	65%

CAST IRON WATER PIPE

Per Net Ton

*6-in. and larger, del'd Chicago.	$51.00
6-in. and larger, del'd New York	49.00
*6-in. and larger, Birmingham.	43.00
6-in. and larger, f.o.b. dock, San Francisco or Los Angeles....	52.00
F.o.b. dock, Seattle	52.00
4-in. f.o.b. dock, San Francisco or Los Angeles	55.00
F.o.b. dock, Seattle	52.00

Class "A" and gas pipe, $3 extra 4-in. pipe is $3 a ton above 6-in.

Prices for lots of less than 200 tons. For 200 tons and over, 6-in. and larger is $42, Birmingham, and $50 delivered Chicago and 4-in. pipe, $45, Birmingham, and $54 delivered Chicago.

BOLTS, NUTS, RIVETS, SET SCREWS

Bolts and Nuts

(F.o.b. Pittsburgh, Cleveland, Birmingham or Chicago)

Per Cent Off List

Machine and carriage bolts: ½ in. & 6 in. and smaller.	65, 5 and 5*
Larger and longer up to 1 in.	60, 10 and 5*
1⅛ in. and larger	60, 5 and 5*
Lag bolts	60, 10 and 5
Plow bolts, Nos. 1, 2, 3 and 7	65, 5 and 5
Hot pressed nuts, and c.p.c. and t nuts, square or hex. blank or tapped: ½ in. and smaller	65 and 5
9/16 in. to 1 in. inclusive.	60, 5 and 5
1⅛ in. and larger	60 and 5

* Less carload lots and less than full container quantity. Less carloads lots in full container quantity, an additional 10 per cent discount; carload lots and full container quantity, still another 5 per cent discount.

Semi-fin. hexagon nuts	U.S.S.	S.A.E.
¼ to 7/16 in. incl.	65-10	70-5
½ to 9/16 in.	65-5	70
⅝ to 1-in. incl.	60-10	65
1⅛ in. and larger	60-5	60-5

Beyond the above, an additional 10 per cent allowed for full container quantities.

Stove bolts in packages, nuts attached	75
Stove bolts in packages, with nuts separate	75 and 12½
Stove bolts in bulk	85

On stove bolts freight is allowed to destination on 200 lb. and over.

Large Rivets

(½-in. and larger)

Base per 100 Lb.

F.o.b. Pittsburgh, Cleveland Chicago, Birmingham	$3.40

Small Rivets

(7/16-in. and smaller)

Per Cent Off List

F.o.b. Pittsburgh, Cleveland, Chicago, Birmingham	65 and 10

Cap and Set Screws

(Freight allowed to destination)

Per Cent Off List

Milled hexagon head cap screws, 1 in. dia. and smaller	50 and 10
Milled square head set screws, case hardened, 1 in. dia. and smaller	75 and 10
Milled headless set screws, cut thread ¾ in. and smaller	70 and 10
Upset hex. head cap screws U.S.S. or S.A.E. thread 1 in. and smaller	67½ and 10
Upset set screws, cup and oval points	75 and 10
Milled studs	60½ and 10

Alloy and Stainless Steel

Alloy Steel Blooms, Billets and Slabs

F.o.b. Pittsburgh, Chicago, Canton, Massillon, Buffalo, Bethlehem. Base price, $56.00 a gross ton.

Alloy Steel Bars

F.o.b. Pittsburgh, Chicago, Buffalo, Bethlehem, Massillon or Canton.

Open-hearth grade, base	2.80c.
Delivered, Detroit	2.90c.

S.A.E. Series Numbers	Alloy Differential per 100 Lb.
200 (½% Nickel)	$0.35
2100 (1½% Nickel)	0.75
2300 (3½ Nickel)	1.55
2500 (5% nickel)	$2.25
3100 Nickel-chromium	0.70
3200 Nickel-chromium	1.35
3300 Nickel-chromium	3.80
3400 Nickel-chromium	3.20
4100 Chromium-molybdenum (0.15 to 0.25 Molybdenum)	0.55
4100 Chromium-molybdenum (0.25 to 0.40 Molybdenum)	0.75
4600 Nickel-molybdenum (0.20 to 0.30 Mo. 1.50 to 2.00 Ni)	1.10
5100 Chrome steel (0.60-0.90 Cr.)	0.35
5100 Chrome steel (0.80-1.10 Cr.)	0.45
5100 Chromium spring steel	0.15
6100 Chromium-vanadium bar	1.20
6100 Chromium-vanadium spring steel	0.35
Chromium-nickel-vanadium	1.50
Carbon-vanadium	0.35

These prices are for hot-rolled steel bars. The differential for most grades in electric furnace steel is 50c. higher. Slabs with a section area of 16 in. and 2½ in. thick or over take the billet base.

Alloy Cold-Finished Bars

F.o.b. Pittsburgh, Chicago, Gary, Cleveland or Buffalo, 3.40c. base per lb. Delivered Detroit, 3.50c., carlots.

CORROSION & HEAT RESISTANT ALLOYS

(Base prices, cents per lb., f.o.b. Pittsburgh)

Chrome-Nickel

	No. 304	No. 302
Forging billets	21.25c.	20.40c.
Bars	25c.	24c.
Plates	29c.	27c.
Structural shapes	25c.	24c.
Sheets	36c.	34c.
Hot-rolled strip	23.50c.	21.50c.
Cold-rolled strip	30c.	28c.
Drawn wire	25c.	24c.

Straight Chrome

	No. 410	No. 430	No. 442	No. 446
Bars	18.50c.	19c.	22.50c.	27.50c.
Plates	21.50c.	22c.	25.50c.	30.50c.
Sheets	26.50c.	29c.	32.50c.	36.50c.
Hot strip	17c.	17.50c.	23c.	28c.
Cold stp.	22c.	22.50c.	28.50c.	36.50c.

TOOL STEEL

High speed	67c.
High-carbon-chrome	43c.
Oil-hardening	24c.
Special	22c.
Extra	18c.
Regular	14c.

Prices for warehouse distribution to all points on or East of Mississippi River are 2c. a lb. higher. West of Mississippi quotations are 3c. a lb. higher.

British and Continental

BRITISH

Per Gross Ton
f.o.b. United Kingdom Ports

Ferromanganese, export	£14 Nominal
Tin plate, per base box	20s. 3d. to 21s. 6d.
Steel bars, open hearth	£11
Beams, open-hearth	£10 12s. 6d.
Channels, open-hearth	£10 17s. 6d.
Angles, open-hearth	£10 12s. 6d.
Black sheets, No. 24 gage	£13
Galvanized sheets, No. 24 gage	£15 5s.

CONTINENTAL

Per Gross Ton, Gold £, f.o.b. Continental Ports

Billets, Thomas	Nominal
Wire rods, No. 5 B.W.G.	£5 10s.
Steel bars, merchant	£5 5s.
Sheet bars	Nominal
Plate ¼ in. and up	£5 7s.
Plate 3/16 in. and 5 mm.	£5 13s.
Sheets ⅛ in.	£5 9s. 6d.
Beams, Thomas	£4 18s.
Angles (Basic)	£4 18s.
Hoops and strip, base	£5 15s.

RAW MATERIALS PRICES

PIG IRON

No. 2 Foundry

F.o.b. Everett, Mass.	$22.75
F.o.b. Bethlehem, Birdsboro and Swedeland, Pa., and Sparrows Point, Md.	$22.00
Delivered Brooklyn	24.50
Delivered Newark or Jersey City	23.53
Delivered Philadelphia	22.84
F.o.b. Neville Island, Erie, Pa., Toledo, Chicago and Youngstown*	21.00
F.o.b. Buffalo	21.00
F.o.b. Detroit	21.00
Southern, delivered Cincinnati	21.06
Northern, delivered, Cincinnati	21.44
F.o.b. Duluth	21.50
F.o.b. Provo, Utah	19.00
Delivered, San Francisco, Los Angeles or Seattle	23.95
F.o.b. Birmingham*	17.38

* Delivered prices on southern iron for shipment to northern points are 38c. a ton below delivered prices from nearest northern basing point on iron with phosphorus content of 0.70 per cent and over.

Malleable

Base prices on malleable iron are 50c. a ton above No. 2 foundry quotations at Everett, Eastern Pennsylvania furnaces, Erie and Buffalo. Elsewhere they are the same, except at Birmingham and Provo, which are not malleable iron basing points.

Basic

F.o.b. Everett, Mass.	$22.25
F.o.b. Bethlehem, Birdsboro, Swedeland and Steelton, Pa., and Sparrows Point, Md.	21.50
F.o.b. Buffalo	20.00
F.o.b. Neville Island, Erie, Pa. Toledo, Chicago and Youngstown	20.50
Delivered Philadelphia	22.34
Delivered Canton, Ohio	21.89
Delivered Mansfield, Ohio	22.44
F.o.b. Birmingham	16.00

Bessemer

F.o.b. Buffalo	$22.00
F.o.b. Everett, Mass.	23.75
F.o.b. Bethlehem, Birdsboro and Swedeland, Pa.	23.00
Delivered Newark or Jersey City	24.53
Erie, Pa., and Duluth	22.00
F.o.b. Neville Island, Toledo, Chicago and Youngstown	21.50
F.o.b. Birmingham	22.00
Delivered Cincinnati	22.11
Delivered Canton, Ohio	22.89
Delivered Mansfield, Ohio	23.44

Low Phosphorus

Basing points: Birdsboro, Pa. Steelton, Pa., and Standish, N. Y.	$25.50 to $26.50

Gray Forge

Valley or Pittsburgh furnace	$20.50

Charcoal

Lake Superior furnace	$25.00
Delivered Chicago	28.34

Canadian Pig Iron

Per Gross Ton

Delivered Toronto

No. 1 fdy., sil. 2.25 to 2.75	$26.50
No. 2 fdy., sil. 1.75 to 2.25	25.50
Malleable	26.00
Basic	25.50

Delivered Montreal

No. 1 fdy., sil. 2.25 to 2.75	$27.50
No. 2 fdy., sil. 1.75 to 2.25	27.00
Malleable	27.50
Basic	27.00

FERROALLOYS

Ferromanganese

F.o.b. New York, Philadelphia, Baltimore, Mobile or New Orleans.

Per Gross Ton

Domestic, 80% (carload)	$92.50

Spiegeleisen

Per Gross Ton Furnace

Domestic, 19 to 21%	$28.00
Domestic, 26 to 28%	33.00

Electric Ferrosilicon

Per Gross Ton Delivered; Lump Size

50% (carload lots, bulk)	$69.50*
50% (ton lots in 50 gal. bbl.)	80.50*
75% (carload lots, bulk)	126.00*
75% (ton lots in 50 gal. bbl.)	139.00*

Bessemer Ferrosilicon

F.o.b. Furnace, Jackson, Ohio

Per Gross Ton

10.00 to 10.50%	$30.50

For each additional 0.50% silicon up to 12%, 50c. per ton is added. Above 12% add 75c. per ton.

For each unit of manganese over 2%, 1 per ton additional. Phosphorus 0.75% or over, $1 per ton additional.

Base prices at Buffalo are $1.25 a ton higher than at Jackson.

Silvery Iron

Per Gross Ton

F.o.b. Jackson, Ohio, 5.00 to 5.50%	$24.50

For each additional 0.5% silicon up to 12%, 50c. a ton is added. Above 12% add 75c. a ton.

The lower all-rail delivered price from Jackson or Buffalo is quoted with freight allowed. Base prices at Buffalo are $1.25 a ton higher than at Jackson.

Manganese, each unit over 2%, $1 a ton additional. Phosphorus 0.75% or over, $1 a ton additional.

Ferrochrome

Per Lb. Contained Cr., Delivered Carlots, Lump Size, on Contract

4 to 6% carbon	10.50c.*
2% carbon	16.50c.*
1% carbon	17.50c.*
0.10% carbon	19.50c.*
0.06% carbon	20.00c.*

Silico-manganese

Per Gross Ton, Delivered, Lump Size, Bulk, on Contract

3% carbon	$92.75
2.50% carbon	97.75
2% carbon	102.75
1% carbon	112.75

Other Ferroalloys

Ferrotungsten, per lb. contained W del., carloads, nominally	$2.00
Ferrotungsten, lots of 500 lbs. nominally	2.05
Ferrotungsten, smaller lots, nominally	2.10
Ferrovanadium, contract, per lb. contained V., delivered	$2.70 to $2.90†
Ferrocolumbium, per lb. contained columbium, f.o.b. Niagara Falls, N. Y., tons lots.	$2.25†
Ferrocarbontitanium, 15 to 18% Ti, 7 to 8% C, f.o.b. furnace carload and contract per net ton	$142.50
Ferrocarbontitanium, 17 to 20% Ti, 3 to 5% C, f.o.b. furnace, carload and contract, per net ton	$157.50
Ferrophosphorus, electric or blast furnace material, in carloads, f.o.b. Anniston, Ala., for 18%, with $3 unitage, freight equalized with Rockdale, Tenn., per gross ton	$58.50
Ferrophosphorus, electrolytic, 23-26% in car lots, f.o.b. Monsanto (Siglo), Tenn., 24%, per gross ton, $3 unitage, freight equalized with Nashville	$75.00
Ferromolybdenum, per lb. Mo. f.o.b. furnace	95c.
Calcium molybdate, per lb. Mo. f.o.b. furnace	80c.

*Spot prices are $5 per ton higher
†Spot prices are 10c. per lb. of contained element higher.

ORES

Lake Superior Ores

Delivered Lower Lake Ports

Per Net Ton

Old range, Bessemer, 51.50%	$5.25
Old range, non-Bessemer, 51.50%	5.10
Messabi, Bessemer, 51.50%	5.10
Messabi, non-Bessemer, 51.50%	4.95
High phosphorus, 51.50%	4.85

Foreign Ore

C.i.f. Philadelphia or Baltimore

Per Unit

Iron, low phos., copper free, 55 to 58% dry, Algeria	13c.
Iron, low phos., Swedish, average, 68½% iron	15c.
Iron, basic or foundry, Swedish, aver. 65% iron	13c.
Iron, basic or foundry, Russian, aver. 65% iron	Nominal
Man., Caucasian, washed 52%	35c.
Man., African, Indian, 44-48%	33c.
Man., African, Indian, 49-51%	35c.
Man., Brazilian, 46 to 48½%	33c.

Per Short Ton Unit

Tungsten, Chinese, Wolframite, duty paid, delivered	$20.00
Tungsten, domestic, scheelite delivered	$19.00 to $20.00
Chrome ore (lump) c.i.f. Atlantic Seaboard, per gross ton: South African (low grade)	15.00
Rhodesian, 45%	19.50
Rhodesian, 48%	23.00
Turkish, 48-49%	23.50 to 24.50
Turkish, 45-46%	22.50
Turkish, 44%	18.00
Chrome concentrates (Turkish) c.i.f. Atlantic Seaboard, per gross ton: 50%	24.50 to 25.50
48-49%	24.50 to 25.00

FLUORSPAR

Per Net Ton

Domestic washed gravel, 85-5, f.o.b. Kentucky and Illinois mines, all rail	18.00
Domestic, f.o.b. Ohio River landing barges	18.00
No. 2 lump, 85-5, f.o.b. Kentucky and Ill. mines	$18.00 to 19.00
Foreign, 85% calcium, fluoride, not over 5% silicon, c.i.f. Atlantic ports, duty paid	24.50
Domestic No. 1 ground bulk, 95 to 98% calcium fluoride, not over 2½% silicon, f.o.b. Illinois and Kentucky mines	31.50

FUEL OIL

Per Gal.

No. 2 or diesel, f.o.b. Bayonne	4.125c.
No. 6, f.o.b. Bayonne	2.26c.
Del'd Chicago, No. 5 Bur. Stds.	3.25c.
Del'd Chicago, No. 6 Bur. Stds.	2.75c.
Del'd Cleve'd, No. 3 distillate	5.50c.
Del'd Cleve'd, No. 4 industrial	5.25c.
Del'd Cleve'd, No. 5 industrial	3.00c.
Del'd Cleve'd, No. 6 industrial	2.75c.

COKE

Per Net Ton

Furnace, f.o.b. Connellsville, Prompt	$3.75
Foundry, f.o.b. Connellsville, Prompt	$4.75 to 5.50
Foundry, by-product, Chicago ovens	10.25
Foundry, by-product, del'd New England	12.50
Foundry, by-product, del'd Newark or Jersey City	10.88 to 11.40
Foundry, by-product, Philadelphia	10.95
Foundry, by-product, delivered Cleveland	10.30
Foundry, by-product, delivered Cincinnati	9.75
Foundry, Birmingham	7.50
Foundry, by-product, del'd St. Louis industrial district	10.75 to 11.00
Foundry, from Birmingham, f.o.b. cars dock, Pacific ports	14.75

IRON AND STEEL WAREHOUSE PRICES

PITTSBURGH

	Base per Lb.
Plates	3.55c.
Shapes	3.55c.
Soft steel bars and small shapes	3.60c.
**Reinforcing steel bars	2.70c.
Cold finished bars and screw stock	3.95c.
Hot rolled strip	3.75c.
Hot rolled sheets	3.50c.
Galv. sheets (24 ga.) 500 lb. to 1499 lb.	4.50c.
Wire, black, soft annealed	3.15c.
Wire, galv., soft	3.55c.
Track spikes (1 to 24 kegs)	3.75c.
Wire nails (in 100-lb. kegs)	2.65c.

On plates, structurals, bars, strip and hot rolled sheets, base applied to orders of 400 to 1999 lb.

** On reinforcing bars base applies to orders of less than one ton and includes switching and carting charge.

All above prices for delivery within the Pittsburgh switching district.

NEW YORK

	Base per Lb.
Plates, ¼ in. and heavier	3.83c.
Structural shapes	3.75c.
Soft steel bars, round	3.94c.
Iron bars, Swed. charcoal	7.50 to 8.25c.
Cold-fin. shafting and screw stock:	
Rounds, squares, hexagons	4.39c.
Flats up to 12 in. wide	4.39c.
Cold-rolled strip, soft and quarter hard	3.66c.
Hot-rolled strip, soft O.H.	4.11c.
Hot-rolled sheets (10 ga.)	3.73c.
Galv. sheets (24 ga.)	4.60 to 4.85c.
Long ternes (24 ga.)	5.50 to 6.20c.
Cold-rolled sheets (20 ga.)	
Standard quality	4.90c.
Deep drawing	5.10c.
Stretcher leveled	5.50c.
SAE, 2300, hot-rolled	7.50c.
SAE, 3100, hot-rolled	6.10c.
SAE, 6100, hot-rolled annealed	10.25c.
SAE, 2300, cold-rolled	8.69c.
SAE, 3100, cold-rolled, annealed	7.29c.
Floor plate, ¼ in. and heavier	5.43c.
Standard tool steel	12.50c.
Wire, black, annealed (No. 9)	4.65c.
Wire, galv. (No. 9)	5.00c.
Open-hearth spring steel	4.75c. to 10.25c.
Common wire nails, per keg in 25 keg lots	$3.25

CHICAGO

	Base per Lb.
Plates and structural shapes	3.55c.
Soft steel bars, rounds and angles	3.60c.
Soft steel squares, hexagons, channels and Tees	3.75c.
Hot rolled strip	3.75c.
Floor plates	5.15c.
Hot rolled sheets	3.50c.
Galvanized sheets	4.50c.
Cold rolled sheets	4.45c.
Cold finished carbon bars	4.05c.

Above prices are subject to deductions and extras for quantity and are f.o.b. consumer's plant within Chicago free delivery zone.

CLEVELAND

	Base per Lb.
Plates	3.55c.
Structural shapes	3.73c.
Soft steel bars	3.50c.
Reinfor. bars (under 2000 lb.)†	2.55c.
Cold-fin. bars (1000 lb., over)	4.05c.
Hot-rolled strip, 6 in. wide and under	3.65c.
Cold rolled sheets	4.70c.
Cold-finished strip	3.35c.
Galvanized sheets (No. 24)	4.68c.
Hot-rolled sheets	3.50c.
Floor plates, 3/16 in. and heavier	5.33c.
*Black ann'l'd wire, per 100 lb.	$3.10
*No. 9 galv. wire, per 100 lb.	3.50
*Com. wire nails, base per keg	2.60
Hot rolled alloy steel (3100)	6.05c.
Cold rolled alloy steel (3115)	6.85c.

* For 5000 lb. or less
† 500 lb., base quantity.

ST. LOUIS

	Base per Lb.
Plates and structural shapes	3.82c.
Bars, soft steel (rounds and flats)	3.87c.
Bars, soft steel (squares, hexagons, ovals, half ovals and half rounds)	4.02c.
Cold fin. rounds, shafting, screw stock	4.32c.
Galv. sheets (24 ga.)	4.77c.
Hot rolled sheets	3.77c.
Galv. corrugated sheets, 24 ga. and heavier*	4.82c.
Structural rivets	5.02c.

* No. 26 and lighter take special prices.

BOSTON

	Base per Lb.
Structural shapes, 3 in. and larger	5.85c.
Plates, ¼ in. and heavier	3.85c.
Bars	3.98c.
Heavy hot rolled sheets	3.86c.
Hot rolled sheets	4.21c.
Hot rolled annealed sheets	4.76c.
Galvanized sheets	4.76c.
Cold rolled sheets	4.93c.

BUFFALO

	Base per Lb.
Plates	3.77c.
Floor plates	5.40c.
Struc. shapes	3.55c.
Soft steel bars	3.60c.
Reinforcing bars (20,000 lb. or more)	2.05c.
Cold-fin. flats, squares, rounds, and hex.	4.05c.
Hot-rolled sheets, 3/16 x 14 in. to 48 in. wide incl. also sizes No. 8 to 30 ga.	3.50c.
Galv. sheets (24 ga.)	4.50c.
Bands and hoops	3.97c.

NEW ORLEANS

	Base per Lb.
Mild steel bars	4.20c.
Reinforcing bars	3.24c.
Structural shapes	4.10c.
Plates	4.10c.
Hot-rolled sheets, No. 10	4.35c.
Steel bands	4.75c.
Cold-finished steel bars	5.10c.
Structural rivets	4.85c.
Boiler rivets	4.85c.
Common wire nails, base per keg	3.55
Bolts and nuts, per cent off list	60

REFRACTORIES PRICES

Fire Clay Brick

	Per 1000 f.o.b. Works
Super-duty brick, at St. Louis	$60.80
First quality Pennsylvania, Maryland, Kentucky, Missouri and Illinois	47.50
First quality, New Jersey	52.50
Second quality, Pennsylvania, Maryland, Kentucky, Missouri and Illinois	42.75
Second quality, New Jersey	49.00
No. 1, Ohio	39.90
Ground fire clay, per ton	7.10

Silica Brick

	Per 1000 f.o.b. Works
Pennsylvania	$47.50
Chicago District	56.05
Birmingham	47.50
Silica cement per net ton (Eastern)	8.55

Chrome Brick

	Per Net Ton
Standard f.o.b. Baltimore, Plymouth Meeting and Chester	$47.00
Chemically bonded f.o.b. Baltimore, Plymouth Meeting and Chester, Pa.	47.00

Magnesite Brick

	Per Net Ton
Standard f.o.b. Baltimore and Chester	$67.00
Chemically bonded, f.o.b. Baltimore	57.00

Grain Magnesite

	Per Net Ton
Imported, f.o.b. Baltimore and Chester, Pa. (in sacks)	$45.00
Domestic, f.o.b. Baltimore and Chester, in sacks	40.00
Domestic, f.o.b. Chewelah Wash. (in bulk)	22.00

PHILADELPHIA

	Base per Lb.
*Plates, ¼-in. and heavier	3.40c.
*Structural shapes	3.40c.
*Soft steel bars, small shapes, iron bars (except bands)	3.60c.
‡Reinforc. steel bars, square and deformed	2.86c.
Cold-finished steel bars	4.36c.
*Steel hoops	4.10c.
*Steel bands, No. 12 and 3/16 in. incl.	3.60c.
*Spring steel	4.75c.
†Hot-rolled anneal. sheets	3.40c.
†Galvanized sheets (No. 24)	4.50c.
*Diam. pat. floor plates, ¼ in.	5.00c.

These prices are for delivery in Philadelphia trucking area.

*Base prices subject to deduction on orders aggregating 4000 lb. or over.

†For 25 bundles or over.

‡For less than 2000 lb.

BIRMINGHAM

Bars and bar shapes	$3.85 base	
Structural shapes and plates	3.75 "	
Hot rolled sheets No. 10 ga.	3.80 "	
Hot rolled sheets No. 24 ga.	4.40 "	3500 lb. and over
Galvanized sheets No. 24 ga.	5.05 "	3500 lb. or more
Strip	4.05 "	
Reinforcing bars	3.85 "	
Floor plates	5.96 "	
Cold finished bars	4.91 "	
Machine and carriage bolts	.50 & 10 off list	
Rivets (structural)	$4.60 base	

On plates, shapes, bars, hot-rolled strip heavy hot-rolled sheets, the base applies on 400 to 3999 lb. All prices are f.o.b. consumer's plant.

PACIFIC COAST

	Base per Lb.		
	San Francisco	Los Angeles	Seattle
Plates, tank and U. M.	3.85c.	4.00c.	4.05c.
Shapes, standard	3.95c.	4.00c.	4.05c.
Soft steel bars	4.05c.	4.00c.	4.30c.
Reinforcing bars, f.o.b. cars dock Pacific ports	2.675c.	2.975c.	2.975c.
Hot-rolled sheets (No. 10)	4.00c.	4.20c.	4.20c.
Galv. sheets (No. 24 and lighter)	5.15c.	5.05c.	5.50c.
Galv. sheets (No. 22 and heavier)	5.50c.	5.05c.	5.50c.
Cold-finished steel			
Rounds	6.55c.	6.60c.	7.10c.
Squares and hexagons	7.80c.	7.85c.	7.10c.
Flats	8.30c.	8.35c.	8.10c.
Common wire nails,—base per keg less carload	$3.20	$3.05	$3.00

All items subject to differentials for quantity.

ST. PAUL

	Base per Lb.
Mild steel bars, rounds	4.10c.
Structural shapes	4.00c.
Plates	4.00c.
Cold-finished bars	4.83c.
Hot-rolled annealed sheets, No. 24	4.75c.
Galvanized sheets, No. 24	5.00c.

On mild steel bars, shapes and plates the base applies on 400 to 14,999 lb. On hot-rolled sheets, galvanized sheets and cold-rolled sheets base applies on 15,000 lb. and over. Base on cold-finished bars is 1000 lb. and over of a size.

PLANT EXPANSION AND EQUIPMENT BUYING

NORTH ATLANTIC

Singer Sewing Machine Co., 149 Broadway, New York, has filed plans for new three-story and basement branch plant, 48 x 90 ft., at Congress and Purchase Streets, Boston, for which general contract has been let to Turner Construction Co., 143 Newbury Street, Boston. It will be equipped for light production, including assembling, with portion reserved for office and operating service. Cost over $100,000 with equipment. Little & Russell, 20 Newbury Street, Boston, are architects.

Signal Corps Procurement District, Army Base, 58th Street and First Avenue, Brooklyn, asks bids until Oct. 19 for airport controls (Circular 49); until Oct. 31 for 50 to 1000 reel units (Circular 57).

Board of Education, Saratoga Springs, N. Y., plans manual training department in new three-story junior high school. Cost about $600,000. Financing in part is being arranged through Federal aid. Louis E. Jallade, 597 Fifth Avenue, New York, is architect.

Bureau of Supplies and Accounts, Navy Department, Washington, asks bids until Oct. 21 for motor-driven centrifugal pumps (Schedule 4552) for Brooklyn, Philadelphia and Norfolk, Va., Navy Yards; until Oct. 25 for four steel flasks (Schedule 4624) for Brooklyn Yard; 50,500 non-watertight attachment plugs (Schedule 4578) for Brooklyn and Sewall's Point Yards; one diesel engine-driven electric generating set (Schedule 4589) for New York Navy Yard.

New York Steam Corp., 130 East 15th Street, New York, has filed plans for improvements and alterations in steam power generating plant at 504 East 59th Street. Cost over $40,000 with equipment. W. H. Paine is company architect.

Commanding Officer, Ordnance Department, Watervliet Arsenal, Watervliet, N. Y., asks bids until Oct. 17 for quantity of alloy steel forgings and tubes for 37 mm. gun (Circular 42); until Oct. 21 for one universal milling machine (Circular 39); until Oct. 24 for one 50-ton capacity hydraulic straightening press (Circular 40).

Sinclair Refining Co., 630 Fifth Avenue, New York, has work under way on rebuilding of portion of main oil refining plant at Wellsville, N. Y., destroyed by fire a number of weeks ago, with loss reported close to $1,000,000 with equipment. An award for different features of work has been let to Lummus Co., 420 Lexington Avenue, New York.

Constructing Quartermaster, Plattsburg Barracks, Plattsburg, N. Y., asks bids until Oct. 17 for quantity of armored cable (Circular 6384-20); until Oct. 18 for quantity of reinforcing bars, expansion bolts, etc. (Circular 6384-21).

Board of Education, Bloomfield, N. J., plans manual training department in new three-story and basement junior high school on Franklin Street, for which bids will be asked soon on general contract. Cost about $1,200,000. Financing has been arranged through Federal aid. Starrett & Van Vleck, 367 Fifth Avenue, are architects, and Purdy & Henderson Associates, Inc., 45 East Seventeenth Street, engineers, both New York.

Constructing Quartermaster, Camp Dix, near Wrightstown, N. J., has let general contract to William C. Ehret, 209 Academy Street, Trenton, N. J., for one-story machine repair and garage building for army motor trucks, 60 x 120 ft., at $30,000, exclusive of equipment.

Commanding Officer, Ordnance Department, Picatinny Arsenal, near Dover, N. J., asks bids until Oct. 19 for two precision surface grinding machines (Circular 291); until Oct. 24 for 12 melting and mixing kettles, each with capacity of 150 gal. (Circular 254).

A. P. DeSanno & Son, 1612 McKean Street, Philadelphia, manufacturer of grinding wheels and other abrasive products, has purchased former mill of Ajax Hosiery Co., Phoenixville, near Philadelphia, comprising several units, and will improve and equip for plant.

Supply Officer, Naval Aircraft Factory Navy Yard, Philadelphia, asks bids until Oct. 18 for quantity of brass turnbuckle barrels, turnbuckle forks, corrosion-resistant steel bomb control cable and cable terminals (Aero Req. 607).

Bureau of Supplies and Accounts, Navy Department, Washington, asks bids until Oct. 18 for two heavy-duty, motor-driven snagging double end grinders (Schedule 4532) for Philadelphia Navy Yard.

Commanding Officer, Ordnance Department, Frankford Arsenal, Philadelphia, asks bids until Oct. 18 for one centrifugal oil extractor (Circular 313).

BUFFALO DISTRICT

Lawless Brothers Paper Mills, Inc., East Rochester, N. Y., has approved plans for one-story addition, 55 x 240 ft., for storage and distribution. Contract for structural steel framing has been let to Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh. Cost over $65,000 with equipment.

United States Engineer Office, Federal Building, Buffalo, asks bids until Oct. 17 for plate pump liners, drilled, complete, without bolts (Circular 41); until Oct. 20 for two cast steel slip joints, six cast steel elbows, two cast steel taper pipes and one cast steel ball joint (Circular 43).

Board of Education, Lewiston, N. Y., plans manual training department in new two-story central school. Cost about $600,000. Financing is being arranged through Federal aid. Bley & Lyman, 505 Delaware Avenue, Buffalo, are architects.

WASHINGTON DIST.

Quartermaster, Marine Corps, Washington, asks bids until Oct. 19 for five track-laying type tractors for Quantico, Va. (Schedule 203).

City Council, South Hill, Va., plans new municipal electric power plant. Bonds for $82,500 have been voted and additional financing will be arranged through Federal aid. Wiley & Wilson, Richmond, Va., are consulting engineers.

General Purchasing Officer, Panama Canal, Washington, asks bids until Oct. 20 for one 4000-bbl. capacity oil storage tank, quantity of galvanized straps, galvanized clips, wrought iron pipe, gate valves, 36 oxygen cylinder valves, 5000 ft. of copper cable, quantity of magnet wire, toggle switches, hand taps, stone drills, screw clamps, spading forks, steel wire wheel brushes, 18,144 flashlight batteries, panelboards and other equipment (Schedule 3390).

Bureau of Yards and Docks, Navy Department, Washington, asks bids (no closing date stated) for diesel-electric portal crane, consisting of revolving hinged jib, A-frame, and machinery house mounted on traveling gantry for naval operating base, San Diego, Cal. (Specifications 8937).

Easton Utilities Commission, Easton, Md., will take bids soon for extensions and improvements in municipal electrical distributing system, including installation of additional equipment. Fund of $91,300 has been arranged through Federal aid. William Krumbine is engineer.

Bureau of Supplies and Accounts, Navy Department, Washington, asks bids until Oct. 18 for one motor-driven drill press (Schedule 4518), two motor-driven drill presses (Schedule 4545) for Alexandria, Va., yard; two motor-driven automatic thread grinder machines and attachments (Schedule 4538), three motor-driven horizontal boring machines (Schedule 4542), two motor-driven planers (Schedule 4539), one motor-driven metal-cutting band saw (Schedule 4541); until Oct 25 for six motor-driven combination wet and dry grinders (Schedule 4601) for Washington; quantity of brass, bronze, lead, copper and steel wire (Schedule 4543) for Eastern and Western Navy yards.

NEW ENGLAND

Commanding Officer, Ordnance Department, Springfield Armory, Springfield, Mass., asks bids until Oct. 18 for one metal band saw (Circular 102); until Oct. 21 for one lot complete line of woodworking machinery for machining stock and hand guards (Circular 86); until Oct. 26 for two cylindrical plain grinder machines (Circular 89); until Oct. 27 for one two-spindle, vertical drill press (Circular 87), one high-speed milling, drilling and boring attachment (Circular 93).

Bridgeport Brass Co., Bridgeport, Conn., has asked bids on general contract for one-story addition, 110 x 220 ft., to tube mill on Housatonic Avenue. Cost over $100,000 with equipment. Fletcher-Thompson, Inc., 1336 Fairfield Avenue, Fairfield, Conn., is architect and engineer.

Bureau of Supplies and Accounts, Navy Department, Washington, asks bids until Oct. 18 for one motor-driven, hydraulic-type surface grinder (Schedule 4530) for Boston Navy Yard; one motor-driven, precision toolmaker's lathe (Schedule 4527), 50,000 aluminum cartridge tanks (Schedule 4519); until Oct. 25 for two motor-driven lathes (Schedule 4576) for Portsmouth, N. H., Navy Yard; until Oct. 21 for three motor-driven lathes (Schedule 4570) for Newport, R. I., naval station.

Board of School Trustees, New Britain, Conn., has asked bids on general contract for three-story trade and vocational school on Washington Street. Cost about $290,000 with equipment. Financing has been arranged through Federal aid. Warren S. Holmes Co., 30 Farmington Avenue, Hartford, Conn., is architect.

SOUTH ATLANTIC

Coca-Cola Bottling Co., Apalachicola, Fla., has asked bids on general contract for one-story addition to mechanical-bottling, storage and distributing plant. Cost over $45,000 with equipment. Robert & Co., Bona Allen Building, Atlanta, Ga., are architects and engineers.

Morton Chemical Co., Greensboro, N. C., recently organized with capital of $100,000 to manufacture industrial chemicals and take over plant and business of Textile Chemical Products Co., High Point Road, has approved plans for expansion in plant, with installation of considerable additional equipment. J. R. Morton is president and treasurer.

SOUTHWEST

Johnston Tin Foil & Metal Co., 6106 South Broadway, St. Louis, has asked bids on general contract for one-story addition, 100 x 100 ft. Cost over $50,000 with equipment. O'Meara & Hills, 5709 Waterman Street, are architects.

City Council, Girard, Kan., plans expansion and improvements in municipal electric light and power plant, and waterworks station, with installation of additional equipment. Cost about $135,000. Financing has been arranged through Federal aid. E. T. Archer & Co., New England Building, Kansas City, Mo., are consulting engineers.

Anheuser-Busch, Inc., 721 Pestalozzi Street, St. Louis, has filed plans for four-story addition, 34 x 50 ft., at brewery, to be used for storage and distribution. General contract has been let to Edwin Ahlskog, 407 South Dearborn Street, Chicago. Cost about $60,000.

Board of Jackson County Commissioners, Holton, Kan., has approved plans for one-story and basement mechanical shop, 40 x 114 ft., for maintenance and repair of highway and other equipment. Cost over $50,000 with equipment. Financing has been arranged through Federal aid. Paul Anderson is county engineer.

City Council, Chelsea, Okla., plans extensions and improvements in municipal electric

power plant, including installation of new diesel engine unit and auxiliary equipment. Cost about $58,000. Financing has been arranged through Federal aid. V. V. Long & Co., Colcord Building, Oklahoma City, Okla., are consulting engineers.

American Chain & Cable Co., 905 Live Oak Street, Houston, Tex., has let general contract to C. M. Davis, Insurance Building, Fort Worth, Tex., for new one-story plant on Cliette Street, 150 x 250 ft. Cost over $85,000 with equipment.

City Council, Wellington, Tex., plans municipal electric power plant and electrical distributing system. Cost about $160,000. A bond issue has been voted and further financing is being arranged through Federal aid. Cornell & Co., Oliver-Eakle Building, Amarillo, Tex., are consulting engineers.

McDavitt & Lightner Co., Inc., East Brownsville, Tex., food packer, has approved plans for one-story addition. Cost close to $40,000 with equipment.

SOUTH CENTRAL

Campbell Oil Co., Chattanooga, Tenn., S. H. Campbell, Jr., president, plans new bulk oil storage and distributing terminal on Tennessee River, where site is being secured. Cost close to $60,000 with steel tanks, pumping equipment and other operating facilities.

Common Council, Burkesville, Ky., is considering new municipal electric power plant. Cost over $100,000 with equipment. Financing will be arranged through Federal aid. J. S. Watkins, McClelland Building, Lexington, Ky., is consulting engineer.

Board of Trustees, University of Alabama, University, Ala., will ask bids soon on general contract for one-story shop building and extensions and improvements in power house used for Comer Hall group of buildings, with improvements in last noted structures. Fund of $163,650 has been arranged through Federal aid.

City Council, Corbin, Ky., plans extensions and improvements in municipal electric power plant and waterworks station, including installation of additional equipment. Cost about $400,000. Financing has been arranged through Federal aid. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

WESTERN PA. DIST.

Ellwood Forge Co., Ellwood City, Pa., plans establishment of new plant unit for crankshaft manufacturing division, heretofore occupying leased space in former local building of Stronach Nail Co., owned by Chamber of Commerce, recently destroyed by fire. Loss over $50,000 with equipment.

United Carbon Co., Charleston, W. Va., has authorized extensions and improvements in branch plant at Sayre, Okla., including installation of additional equipment. Cost close to $80,000 with machinery.

General State Authority, 112 North Second Street, Harrisburg, Pa., A. S. Janeway, executive director, plans vocational department in new state school at Polk, Pa., to comprise several large buildings. Cost about $730,000 with equipment.

OHIO AND INDIANA

Dill Mfg. Co., 694 East Eighty-second Street, Cleveland, manufacturer of screw machine products, sheet metal stampings, etc., has let general contract to D. W. Rankin, 1836 Euclid Avenue, for four-story addition, 50 x 60 ft. Cost over $65,000 with equipment. Roberts-Wright Co., Swetland Building, is architect and engineer.

Iron Fireman Mfg. Co., 3170 West 106th Street, Cleveland, has purchased former plant of Lang Body Co., in vicinity of works at 3088 West 106th Street, consisting of tract of six acres of land, improved with a group of one, three and four-story buildings, totaling about 200,000 sq. ft. of floor space. New owner will use for expansion following expiration of leases of several tenants now occupying parts of premises.

City Council, New Washington, Ohio, plans new municipal electric power plant. Cost close to $125,000 with equipment. Financing is being arranged through Federal aid. Carl J. Simon & Associates, Van Wert, Ohio, are consulting engineers.

Contracting Officer, Material Division, Air Corps, Wright Field, Dayton, Ohio, asks bids until Oct. 25 for quantity of generator assemblies, and generator control panel assemblies (Circular 207).

Phoenix Ice Machine Co., 2711 Church Street, Cleveland, manufacturer of ice-making machinery and parts, plans two-story and basement addition on adjoining site, recently acquired. Cost over $50,000 with equipment.

City Council, Columbus Grove, Ohio, plans expansion and improvements in municipal steam power plant, used for central heating service, including installation of additional equipment. Cost about $32,500. Financing is being arranged through Federal aid. Carl J. Simon & Associates, Van Wert, Ohio, are consulting engineers.

Board of Public Works, City Hall, Indianapolis, Louis Brandt, president, has asked bids on general contract for one and two-story steel hangar, with repair and maintenance shop, 112 x 121 ft., at municipal airport. Cost about $100,000 with equipment. Philip Weisenberg, Architects' and Builders' Building, is architect.

MICHIGAN DISTRICT

United States Engineer Office, Federal Building, Detroit, asks bids until Oct. 17 for quantity of galvanized welded wire fabric (Circular 20).

Wall Chemicals, Inc., 1059 West Grand Boulevard, Detroit, manufacturer of industrial oxygen, acetylene, carbonic gas, etc., has approved plans for rebuilding portion of plant recently damaged by fire, and will install new equipment for production.

Village Council, Ecorse, Mich., plans new one-story municipal service, repair and garage building for cars and motor trucks. Cost about $50,000. Financing will be arranged through Federal aid.

Brown Rubber Co., Lafayette, Ind., manufacturer of rubber products, has acquired a controlling interest in Composite Materials Corp., Detroit, organized to manufacture a rubberized product for automobile service. An industrial building at Detroit has been leased from Carborundum Co., owner, and new plant will be established at early date.

City Council, Holland, Mich., has concluded arrangements for a Federal grant of $675,621 to be used for new municipal electric power plant, estimated to cost $1,500,000 with turbo-generators, boilers and auxiliary equipment. Balance of financing will be carried out by city. Hamilton & Weeber, Grand Rapids, Mich., are consulting engineers.

MIDDLE WEST

Creamery Package Co., 1243 West Washington Boulevard, Chicago, manufacturer of dairy machinery and equipment, has approved plans for two-story and basement addition to branch plant at Arlington Heights, Ill. Award for structural steel framing has been made to Vierling Steel Works, 313 West Twenty-third Street, Chicago. Cost over $50,000 with equipment.

Chicago & Northwestern Railway Co., 400 West Madison Street, Chicago, is considering improvements in power house at shops at Winona, Minn., to include installation of new boiler units and other equipment. Proposed to carry out work early next year.

City Council, Ackley, Iowa, asks bids until Oct. 24 for improvements in municipal electric power plant, including new 225-hp. diesel-engine generator unit, with exciter and auxiliary equipment. Ralph W. Gearhart, 341 Twenty-first Avenue, S.E., Cedar Rapids, Iowa, is consulting engineer.

Bureau of Reclamation, Denver, Colo., asks bids until Oct. 21 for one clutch-operated, crawler-traction mounted, full-revolving, diesel engine-powered, convertible type, dragline excavator, equipped with 45-ft. boom, with two-sheave boom tip, two 10-ft. boom insertion pieces, shovel attachment with a one dipper of one cu. yd. capacity, and accessory equipment, for Rio Grande project, New Mexico-Texas. Also for one similar type dragline excavator, equipped with 60-ft. boom, and one 20-ft. boom insertion piece, shovel attachment with one 2½-cu. yd. capacity dipper and complete accessory equipment, for All-American canal system, Boulder Canyon project, Arizona-California-Nevada (Specifications 1130-D).

State Department of Public Buildings, Springfield, Ill., plans new power house at state institution at Alton, Ill. Cost over $150,000 with equipment, of which $78,750 will be secured through Federal aid.

City Council, Rolfe, Iowa, plans new municipal electric power plant. Cost about $100,000 with equipment, of which about $44,550 will be represented by a Federal grant. Young & Stanley, Muscatine, Iowa, are consulting engineers.

Monarch Tool & Machinery Co., 4450 West Fifth Avenue, Chicago, manufacturer of machinery and parts, tools, etc., has let general contract to Rudenberg & Cohen, 1549 South Avers Street, for one-story addition, 50 x 109 ft. Cost over $40,000 with equipment. I. S. Stern, 306 South Wabash Avenue, is architect.

PACIFIC COAST

Parkersburg Rig & Reel Co., 716 East 16th Street, Los Angeles, manufacturer of oil well equipment, with main plant at Parkersburg, W. Va., has let general contract to Austin Co. of California, Los Angeles, for one-story factory branch, storage and distributing plant at Washington and Indiana Streets, Vernon, Los Ageles. Cost about $45,000 with equipment.

Board of Education, 1151 South Broadway, Los Angeles, plans two new one-story vocational shop buildings, each about 40 x 76 ft., at junior high school on Kern Avenue, in connection with other expansion and improvements at school, for which a fund of about $275,000 has been arranged. A. S. Nibecker, Jr., is architect for board.

Bureau of Supplies and Accounts, Navy Department, Washington, asks bids until Oct. 21 for one motor-driven universal shaper (Schedule 4515) for San Diego, Cal., Naval air station; until Oct. 25 for 20 air-turbine-driven portable ventilation fans (Schedule 4567) for Puget Sound, Wash., Navy Yard; until Nov. 1 for motor-generators, controllers and spare parts (Schedule 4595) for Mare Island, Cal., and Puget Sound Navy yards.

Board of Education, San Juan Capistrano, Cal., plans one-story vocational shop, 40 x 87 ft., at local high school. Fund of $118,000 has been arranged through Federal aid for this and other expansion at school. T. C. Kistner, Architects' Building, Los Angeles, is architect.

Supervising Construction Engineer, Indian Service, Billings, Mont., asks bids until Oct. 17 for four-unit vertical centrifugal sump pump, complete with motor and auxiliary equipment, for installation at Fort Hall, Idaho.

FOREIGN

Office of Under-Secretary of State, Public Service, Shareh El Falaki No. 25, Cairo, Egypt, asks bids until Dec. 15 for water towers and accessory equipment for Bosat water works. Plans at office of Consulate General of Egypt, 103 Park Avenue, New York, or office of chief inspecting engineer, Egyptian Government, 41 Tothill Street, London, England.

Burma Lime & Chemical Co., Ltd., Calcutta, Ind., recently organized, care of Bhatter Chunder & Co., Calcutta, managing agents, plans new plant on local site for production of industrial chemical products, hydrated lime and kindred specialties. It will comprise several one-story units. Cost over $350,000 with equipment.

United States Engineer Office, Bonneville, Ore., asks bids until Oct. 18 for steel stop logs for Bonneville hydroelectric power project (Circular 30).

City Council, Eugene, Ore., has plans maturing for new municipal electric power plant. Cost about $600,000, of which $269,623 will be a Federal grant. H. P. Currin, superintendent of electrical department, is engineer.

THIS WEEK'S MACHINE ...TOOL ACTIVITIES...

. . . Scattered domestic buying seen as good omen in many centers . . . Foreign demand affected by war scare, but new sources are opening up . . . Equipment being lined up for Chinese aircraft factory.

Better Buying Activity Seen in Northern Ohio

CLEVELAND — While the movement cannot be called brisk, a certain amount of activity is prevalent throughout northern Ohio. Sales during the past week have included two surface grinders, a radial drill and a large rebuilt milling machine to diverse manufacturing companies. Westinghouse at Lima has received bids on two large toolroom lathes and a grinder and Westinghouse at Mansfield has inquired for a number of items. In Michigan, Timken has bought some equipment, including a lathe or two. Numerous consumers have been taking quotations for their budgets.

Slight Upturn in Midwest; Small Tool Sales Up 35%

CHICAGO—A slight upturn in business in the first week of October is giving hope to machine tool sellers here that the long-awaited period of general improvement has arrived. With the ending of war fears, sentiment appears greatly bettered and some of the tools upon which quotations had already been made are now being released. As general conditions improve, it is expected that many more of these tools will be ordered. Final figures for September show a 35 to 40 per cent increase over August in small tool sales, and orders so far this month are ahead of the like September period by about the same amount. Increased activity at farm equipment plants is providing some optimism and further business is expected after Nov. 1 when the new fiscal year for at least one major company begins. It is heard that some parts for the new Ford brakes will be made by Bendix in South Bend and it may be that additional tools will be necessary for this work. The only busy plants in this district remain those occupied with Federal or foreign orders.

Domestic Ordering Level, Cincinnati Builders Report

CINCINNATI—War scare in Central Europe with subsequent negotiations retarded machine tool business from that area and produced a small market decline in the past week. Domestic ordering was about on a level with the preceding week, but manufacturers report no noticeable trend to this demand yet. The diversification of this ordering, however, indicates broad interest in retooling and is the basis for trade predictions of early market expansion. Foreign business is reported in some quarters to be more difficult to handle, since the shopping tendencies of these buyers stimulate broader competition to present attractive offers. At the same time, delivery demands are shorter with one builder indicating four to five months deadline on heavy tools. Factories are retaining operations at present levels to keep abreast of new business.

New Roller-Leveler Being Built for Body Plant

DETROIT—Construction of a special type roller-leveler for one of the large auto body companies has been revealed. This equipment will be utilized to condition sheet clipping scrap to be used as material for small stampings. Several converted units of this type are understood to be already in service in body plants. Plans are being formed by one automobile accessory company to introduce a disk type brake similar to a disk clutch. No facilities for manufacture are prepared as yet.

Buying Improving Slowly in the East

NEW YORK—The general improvement in diversified buying noted last week is still in evidence, and, although ordering is spotty, the volume and tone of inquiries indicate that machine tool buying will be more widely spread as time goes on. Foreign business is showing no signs of diminution, and while the Russians are still the dominating factor, other countries both in Europe and in the Orient have issued inquiries recently. One of the leading American aeronautical holding companies is acting as buying agent for Chinese interests. Figures are now being taken on several hundred thousand dollars worth of sheet metal machinery and related equipment for an aircraft factory in China.

. CAST IRON PIPE .

Salem, Mass., has awarded 250 tons of 16-in. pipe to the Florence Pipe Co., Florence, N. J.

Rochester, N. H., has under consideration a water supply system to cost $214,458. A PWA $96,506 allotment has been made.

Lincoln, Me., water district has plans for a $315,505 water system, for which the government has granted $118,856. Whitman & Howard, 89 Broad St., Boston, are the engineers.

Bellingham, Mass., will ask bids about Nov. 1 on pipe for a water system, including meters in each water subscriber's home, standpipe, etc. Hayden, Harding & Buchanan, 75 State St., Boston, are the engineers.

Greenfield, Mass., has awarded between 3000 and 4000 ft. of 20-in. pipe to the Florence Pipe Co., Florence, N. J.

Sanbournville, N. H., will ask bids in about a week for $60,000 of pipe, in addition to other water system equipment.

Montice'lo, Utah, has passed bonds to provide $20,000 water system.

Laguna Beach, Cal., Improvement District No. 2, South Coast Water District, is preparing plans for water system costing $75,000, including 8 and 10-in. mains. A. J. Stead, city engineer, Laguna Beach, Cal., is preparing plans.

Laguna County Water District, Laguna Beach, Cal., Improvement District No. 1, plans water system costing $89,000, including 8-in. mains. A. J. Stead, City Engineer, Laguna Beach, Cal., is preparing plans.

Pittsburg, Cal., will take bids Oct. 13 for water system improvements including one mile of 18-in. pipe, cast iron, steel and transite alternates.

Savannah, Ga., plans pipe lines for water system for industrial service to local industries, with filtration and purification plant, pumping station and other operating facilities. Cost estimated at $2,500,000. Financing is being arranged through Federal aid, including loan from RFC. A. S. Goebel is city engineer.

General Purchasing Officer, Panama Canal, Washington, asks bids until Oct. 20 for 18,702 ft. of cast iron water pipe, cast iron water pipe fittings, 14 water pipe bends, and quantity of cast steel pipe fittings (Schedule 3390).

Groesbeck, Tex., closes bids Oct. 17 for pipe lines for water system. Also 200,000-gal. elevated steel tank and tower. Fund of $47,000 has been arranged. Freese & Nichols, Capps Building, Fort Worth, Tex., are consulting engineers.

Falls City, Neb., plans pipe lines for extensions and replacements in water system, including main supply line to connect with new water source, waterworks station at new source and other system facilities. Cost about $420,000, of which $239,360 will represent a bond issue, recently voted, and remainder through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Oceanside, Cal., has plans maturing for pipe lines for extensions and replacements in pipe lines for water system, including 10,840 ft. of 16-in., 2000 ft. of 6-in., and 425 ft. of 10-in.; also fittings, valves and other waterworks equipment. Cost about $61,000, of which $33,000 will represent a bond issue, recently voted, and remainder through Federal aid. Ernest A. Taylor is superintendent of streets in charge.

LaGrande, Ore., plans about 32,700 ft., various sizes, for extensions and replacements in water system. Fund of $176,700 is being arranged through Federal aid for this and other waterworks installation. E. H. Ford is city manager; L. R. Stockman, Baker, Ore., is consulting engineer.

Boone, Iowa, asks bids until Oct. 26 for pipe lines for water system and other waterworks installation. Cost about $101,000. Financing has been concluded through Federal aid. G. A. Nelson is city engineer.

Supervising Construction Engineer, U. S. Indian Service, Billings, Mont., asks bids until Oct. 17 for 2500 ft. of 4-in. bell and spigot cast iron pipe, and 140 ft. of steel well casing for Rushville, Neb.

Coeburn, Va., plans pipe lines for water system and other waterworks installation. Cost close to $65,000, of which $45,000 will represent a bond issue, recently voted, and remainder through Federal aid.